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CYBERNETICS, COMPUTERS AND AUTOMATION TECHNOLOGY

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COMPUTERS UNDERUTILIZED

Moscow SOVETSKAYA ROSSIYA in Russian 14 Nov 81 p 1

[Article by correspondent P. Dobrobaba: "One Computer More or Less .... A Warning Signal"]

[Text] All of the computers now installed in Yakutsk could serve a city of 3 million and still have time to rest. This information was revealed by a computer operated by the Statistical Directorate of the Council of Ministers of the Autonomous Republic. This machine's other electronic colleagues revealed similar impartial information about their daily work load: here is the result.

The computer center in the Department of Applied Mathematics and Computer Technology of the Yakutsk branch of the Siberian Department of the USSR Academy of Sciences, for example, has two machines which serve 65 people. Both of these expensive systems could tick off algorithms 24 hours a day except for a little bit of time for preventive maintenance and unforeseen circumstances. Nonetheless, here is something to think over: the standard working time is always defined as 15.1 hours for some reason. And something else: during January-June 1981 the average daily load of the first machine was 4 hours, while that of the second was 13. The waste could be calculated even without using electronics if we knew the cost of an hour of operation. It turns out that these two computers are underutilized every day by more than 800 rubles, and this modern technology has been operating at this pace for several years ....

Here is the daily work load of some computers in the computer centers of other enterprises and institutions. The "Lenaneftegazgeologiya" production association has two M-222 computers operating 10.1 hours per day, and a YeS-1050 which runs for half an hour daily. The Institute of Physical-Technical Problems of the North has a Nairi-2 which operates 5 hours daily. The Yakutsk State University: Minsk-22 -- 5 hours. Institute of Permafrostology: M-222 -- 6.7 hours daily. With coordination, it would be possible to utilize the total capacity of these machines; however, no one has taken this initiative. Not only that, the permafrost scientists are planning to expand their computer center: the management of the Institute has managed to "push through" an order for a computer far more powerful than the one already in place. In satisfying the

order, the discussion at the Siberian Department of the USSR Academy of Sciences seems to include reasoning which says that "if they ask, we must approve". You would think that nobody would notice if there were one computer more or less in Yakutsk.

Twenty computers are already in place in the capital of the Autonomous Republic. These are primarily third-generation machines, of which there are 40 throughout the entire Yakutskaya ASSR. With an average daily utilization factor of about 30%, the waste increases astronomically. Isn't it now time to create a unified computer center, if only on the basis of the statistical directorate, which has such a heavy work load that the present electronic capacity will soon be outgrown?

Many trips to various offices provided no answer to this question. The computer center managers just shrugged their shoulders. The only one who showed any concern was Ye.K. Surovetskiy, deputy chairman of the Yakutsk Oblast Council of Scientific-Technical Societies and president of the section on management information systems and computer technology. Direct need has made it necessary to plan a meeting for the second quarter of 1982 on the theme "status of introduction and utilization of computer technology and management information system development in the Autonomous Republic".

This problem deserves competent discussion and the development of educated recommendations; nonetheless, it seems time to make some decisions as well.

6900
CSO: 1863/65

IMPROVEMENT OF COMPUTER-CENTER OPERATION

Moscow PLANOVOYE KHOZYAYSTVO in Russian No 10, Oct 81 pp 120-122

[Article by V. Vedishchev, section chief, and G. Khramov, department head, All-Union Scientific Research Institute for Problems in Management Organization: "Efficiency of Computer-Center Operation to New Levels"]

[Text] One of the directions in which the economic mechanism can now be improved lies in improvement of the processing and use of management information. "Basic Directions of the Economic and Social Development of the USSR for the Years 1981-1985 and the Period Extending to 1990," which was adopted by the 26th CPSU Congress, sets forth the task of improving the quality and efficiency of information processing through extensive utilization of the capabilities offered by the electronic computer. These conditions will see the role of computer centers (CC) and the problems involved in improving their efficiency become of increasing importance.

Changeover to a fundamentally new, shared, form of computer use will permit substantial improvement in CC efficiency. The establishment of special-purpose dispatching services in a number of cities in the country, which will be able to load computers in existing CC more fully, will contribute to this improvement as well.

Until recently, computers were introduced on a department or branch basis only, each organization setting up its own CC. Along with its advantages, manifest in the fact that these computers are oriented directly toward the solution of specific economic problems, this method suffers from important deficiencies as well. The number of branch CC increases continually from one year to the next, despite the fact that, for a variety of reasons, many of them cannot fully utilize their existing capacities. CC in a number of regions of the country have as much as 33 per cent of their computer capacity going idle for lack of work and some 30 per cent down because of technical malfunctions. Until the present time there have been no special organizations responsible for managing city and territorial computer centers.

In 1977, to the end of increasing the efficiency with which computer capacity in existing computer centers was being employed, GKNT [State Committee of the USSR Council of Ministers on Science and Technology], jointly with the TsSU SSSR [USSR Central Statistical Administration], planned the organization of an experimental dispatching service (EDS) at the Kiev statistical administration's computer center.

The organization of dispatching services has proceeded at an accelerated pace during recent years. In 1978, for example, EDS were set up in the main computer-operation administrations of the republic central statistical administrations in Alma-Ata and Tbilisi. Plans for 1981-1982 call for the creation of similar services in ten more

cities throughout the country, including Moscow, Novosibirsk, Khar'kov, Odessa and others. During the Eleventh Five-Year Plan period they are to be set up in a number of the country's cities in shared-use computer centers (VTsKP). They have won popularity among users within a comparatively short period of time.

Standard regulations, a procedure for evaluating the economic effectiveness of these regulations, document formats and software packages are now being developed to insure the successful operation of these EDS.

Dispatching services will be responsible for finding additionally available machine time in organizational, enterprise and institutional computer-center machines; establishing by computer the various computer data-processing requirements and on this basis compiling a computer-center load schedule.

Plans call for a dispatching service to inform a user of available machine time and of programs for solving standard problems; assign users to computer centers in a rational manner taking into account specialization, equipment and remoteness and intervene as necessary in programming work. It will also provide consultation in connection the formulation and computer solution of various problems, make necessary information available to a user and store his data and programs in computer center-libraries.

The dispatching service also renders its subscribers services in the way of technical support, makes computers available to users on lease, transmits data to carriers, monitors the correctness of the data as input etc.

The basic document regulating relations between the dispatching service and the user is a contract drawn up in accordance with a standard form. For the performance of certain services the EDS accepts requests for computerized data-processing work, consultations, transfer of primary information onto machine carriers, algorithms and programs to be made available, periodic or one-time information-file service as well as for equipment leases. On the basis of the number of requests and available capacities the service formulates its plan for satisfying these requests.

A head of department will be in charge of a dispatching service. His authority is governed by a regulation pertaining to CC production-department heads, whose responsibilities include methodological, scientific-technical and overall administrative direction. Structurally, the dispatching service constitutes a production department comprising groups responsible for receiving requests, maintaining data files and working with users as well as for consulting.

The request-receiving group monitors requests to insure that they have been properly prepared, formalizes the text involved and then records and transmits the request for further processing. It is the job of the data-file group to store, update and correct data files containing CC, user and software data, which constitutes the raw data required for the management and coordination of territorial resources. The group working with users is directly responsible for concluding contracts and keeping the books on services rendered. The consulting group provides users practical and methodological assistance with a specific group of problems.

Dispatching services are being developed in stages. In the first stage, dispatching is accomplished manually without the use of computers. With the inceasing size of the data file, the second stage sees a changeover to automated data processing. Now in the phase of experimental development is a system of automated dispatching services. The software system is now being introduced in implementation of its first phase. This

software is playing an information-referencing role. It collects, stores, retrieves and transmits information.

This software system permits a dispatching service to satisfy user requests for machine time within minimal periods of time. Practical experience gained from the operation of dispatching services in a number of cities throughout the country has now been generalized. The positive results of the operation of the Kiev experimental dispatching service can be seen from the following figures. At the beginning of 1981 more than 200 CC were in operation throughout the city with a computer inventory of over 600 units. During 1980 some 120 Kiev organizations and enterprises utilized the services of the experimental dispatching system.

Utilization of dispatching services to coordinate CC operations and to increase their loading as compared with CC operating without dispatching services reduced computer idle time in 1980 almost 3-fold from the 1976 figure.

At the beginning of 1980 Alma-Ata counted 100 computer centers disposing of some 200 computers. The dispatching service of the Kazakh SSR coordinates the operation of 40--50 per cent of the computer centers in Alma-Ata. Approximately 70 organizations have made use of its services. The economic efficiency of the operation of the dispatching services organized in cities throughout the country has been analyzed.

Through work performed by the Kiev dispatching center, more than 15,000 hours of machine time were sold to customers in 1980 for a total of 890,700 rubles, 150 and 480,000 rubles respectively the figures for Alma-Ata and Tbilisi. During the years of the Tenth Five-Year Plan the Kiev EDS sold machine time for a total of more than 2.5 million rubles. Operation of the dispatching services in these cities has had a substantial economic impact, which is to be found expressed first of all in the increase in average daily loads on YeS-series computers of 1.5-3 hours in both Kiev and Alma-Ata. The increase in average daily load in Tbilisi has been of roughly the same magnitude.

Calculated in accordance with the procedure for determining economic effectiveness, the annual savings realized from the operation of the Kiev dispatching service has come to some 100,000 rubles. Compared with the savings, expenditures for operating the dispatching service have been relatively low, amounting to 10-15,000 rubles annually.

The successes achieved by these experimental dispatching services, however, could be greater if a number of technical-organizational problems were to be solved. It is clearly necessary to change dispatching services over onto a cost-accounting basis as the most efficient mode of operation. On the one hand, the introduction of cost accounting should be of interest to the self-financing enterprise with which the dispatching service is working and, on the other hand, serve as a stimulus to its own personnel.

One of the reasons for lack of interest in the work of a dispatching service is the fact that it itself does not generate the direct product of the computer center with which it works. To remedy this situation will require the establishment of a specific procedure for payment for services a dispatching service renders its users. A system of mutual accounts involving both dispatching service and subscribers should be developed in objectively acceptable and scientifically based forms and amounts for this purpose.

Both computer centers and enterprises and organizations having no computers of their own utilize dispatching-service services.

In relation to the user the dispatching service acts as an information, advising and consulting agency performing one type of service or another in accordance with user requests. For services rendered the user pays it a certain percentage (1-2 per cent) of

the cost of work actually performed and transfers this amount to the current account of the CC with which the dispatching service is working. It also plays the role of middleman between customer and executor-computer center, which formalize by contract their mutual relationship with respect to the use of machine time.

Computer-center operation should be coordinated so that all contract work is handled by the territorial dispatching service only. Such contracts should acquire legal force after agreement is reached and recorded with the dispatching service.

Dispatching-service operations have been insufficiently effective in consequence of the fact that only 10-20 per cent of the work contracted for between computer centers and their subscribers has been formalized through the service. Increasing the percentage of contract work handled through dispatching services would be one way to achieve substantial improvements in their overall effectiveness. This will require approval of the procedure to be employed in paying for services computer centers render subscribers via a dispatching service which GKNT is now developing jointly with TsSU SSSR and the USSR Ministry of Finance. The USSR Ministry of Finance, however, is obstructing approval of this document.

Improvement of dispatching-service operations is inextricably linked with the efficiency with which are received data on additionally available computer-center capacities. It is also necessary that ministries and departments take more than a perfunctory approach to implementation of the resolution of the interdepartmental council on problems of improving management in the national economic, which declares that subordinate computer centers must make free computer time available for data processing in accordance with dispatching-center suggestion.

For dispatching centers to be able to make these suggestions requires up-to-date information on available departmental computer-center capacities. The interdepartmental council resolution can hardly be implemented if ministry and departmental computer centers make this imformation available only once every six months in accordance with current TsSU SSSR Glavmekhschet [expansion unavailable] forms. The fact is that, on the basis of a subscriber request, the dispatching service has to make the most efficient computer-center assignment. This requires continuously up-to-date information concerning the resources of the centers themselves, information which should include specific data on their type, day of the week, shift etc. Only under these conditions can there be any improvement in the effectiveness of dispatching-center operation.

Introduction of dispatching services will require some modification of the structure and methods of management. Because of the increasing role the dispatching service has come to play and because it has been introduced on such a widespread basis, it would be to advantage to form a body which would be responsible for organizing and coordinating the operations of these services.

8963
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ADMINISTRATIVE CHANGES PROPOSED IN ASU DEVELOPMENT

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 21 Jan 82 p 2

[Article by candidate of technical sciences V. Kopylov: "The Automated Control System: the Responsibility of the Client"]

[Text] Who is more interested in improving the efficiency of automated control systems[ASU]: the developer or the client enterprise? The question is not an idle one, even though, logically, the degree of interest should be the same. But how are things in fact?

The developers are interested in the efficiency of an ASU for two reasons: One, it is necessary for the report. Two, it affects the scale of the economic incentive fund. True, practice confirms that the introduction of an ASU at enterprises of the tractor and agricultural machine building industry is not too reliable. I shall explain why.

Our scientific research and planning institute for automated control systems (NIPIASU) developed and introduced an ASU at tractor and motor plants in Volgograd and also at the tractor parts and standards plant. It was introduced with a certain economic effect, as shown by the documents signed by the plants. But not a single ruble went into the institute's economic incentive fund.

The resons for this were many and would require a special conversation. But I cited the example only in order to show graphically how ineffective the principle of material interest is for the workers in this case. Many ASU developers find themselves in a similar situation when summing up the results of their work because no guarantees are given for material incentive. In such conditions, the efficiency of the ASU operation acquires a purely formal nature for the developers.

And now, let us deal with the interest of the client. He is more worried not about the size of the effect obtained as the result of the introduction of the ASU but about stability and reliability in its operation. This is because losses result from any misfires in solving tasks: the quality of control deteriorates and nonproductive use of time, raw materials and energy resources increases. Moreover, it must be taken into account that the actual saving is always less than the calculated saving, and it is disadvantageous for the client to sign

in advance the documents on the efficiency of the ASU and even more so to deduct assets from the material incentive fund. The client is not interested in formulating documents on efficiency at handover of the system for operation. It is more profitable for him to do this after the reliability of its operation has been verified. In practice, this is several years after the introduction of the ASU.

And so, in fact the interests of these two sides in the existing sysyem of evaluation indicators do not coincide. In order to eliminate this kind of contradiction it would be expedient to extend the time taken to check out an ASU: the first check should be done at the time of handover, and subsequent checks each year for 3 to 5 years after the system goes on line. This would be an adequate time to make final decisions about the quality of system development and efficiency in problem solving. And after this test, funds could be deducted to the economic incentive fund of the development organization on an annual basis in line with the effect achieved. And if the ASU does not provide the calculated effect, the difference between "design" and "actual" effect should be passed on as compensation by the development organization.

The proposed method makes it possible to evaluate seriously the activity of the developer and the client and the enhance their mutual responsibility for the quality of ASU operations and for constantly improving development and introduction methods.

It is essential, in our opinion, to change the organizational structure in ASU development. Now, the main designers of a project are the specialist systems development people. At first glance this appears correct: the developer himself should define the methodology for ASU development. In practice, however, this too often leads to a situation in which the main project designers possess neither the necessary theoretical training nor the production experience. Quite often, judging from my own sector, the main project designer, while solving technical and economic problems, is not able to get by (literally) without someone to guide him--the subsystems specialists.

It is more expedient to transfer the authority of the chief designer to the client, and to give the developer the duties of his deputy, namely, those of leader of the various kinds of ASU backup. The more so since the development of technical tasks for the ASU development (in accordance with the regulations for normativ documents) should be done by the client, not the developer, as is the custom. He knows better the strong and weak sides of his own production facility. And so, if not he, who then should define the tasks for the ASU? It is precisely the client who should be the designer of the model system, while its technical and working design is, of course, a matter for the developer.

For efficient and reliable ASU operation at enterprises it is essential to set up a debugging service. At present, inspection of the ASU operation is done only by the developer. This leads to formal analysis of system function. And as soon as the period of the economic agreement expires, the developer and the client part forever and the ASU is left unattended. It would therefore be a good thing to set up comprehensive teams for system debugging. They could include specialists belonging both to the developer and the client enterprise. Their task: to bring the ASU up to planned efficiency.

9642
CSO: 1863/85

IMPROVING COMPUTER EFFICIENCY

Moscow DEN'GI I KREDIT in Russian No 11, Nov 81 pp 53-56

[Article by P.M. Kolinchenko, computer center chief at the Voronezhskaya Oblast Gosbank office]

[Text] The great significance now given to the development and increased effectiveness of automated control systems and computers systems is common knowledge, and it applies fully also to the USSR Gosbank computer centers.

Today, one of the indicators for the efficient utilization of a computer is the amount of time it is in use, expressed in hours per 24-hour period. The normative for daily use for computers has been set at 15 hours, but this is calculated by calendar days, not working days. It follows from this that in order to reach the established load of 15 hours in every 24 calculating from the number of calendar days in a 5-day week, the load on the computers on working days must be 21.5 hours; and this is the maximum physical load possible for the computer, since 2.5 hours in each 24 are allocated for technical preventive maintenance. In the computer center at the Voronezhskaya Oblast Gosbank office, the computer load is 12 hours, which shows that there is potential for improving the effectiveness of computer use.

It seems that the existing indicator for computer load per 24 hours cannot be considered the main indicator for efficient use of the computer. Computer centers can artificially raise it, thereby reducing the actual effect from the use of the computer. Thus, given a set of eight ATsPU-128 printers we can print task results in about 2 hours. However, in the event of a malfunction in the printers, the time taken to print the results is automatically doubled, and in this connection the load indicator for the computer in hours immediately grows, even though the actual operation of the computer center deteriorates. When fulfilling the task for the "operational day," both the computer centers and the Gosbank establishments they serve are interested in the fastest possible processing of the data, the production of the advice note for the initial interbranch circulation as rapidly as possible (so that the Gosbank establishments can send them off to the B branches in time), and in the fastest possible printout of all task decisions so that materials can be sent off in good time to the establishments serviced that are located at any considerable distance from the computer center. And the qualitative completion of these tasks is the real effect of our work, which, however, is not reflected in the indicator for the load on the computer, in hours.

In this connection, in our view, it would be necessary to work out an indicator or group of indicators that would characterize more completely the operation of the computer center.

Efficiency in the use of a computer depends on the following factors: the quality of the work done by servicing personnel--the qualifications of the mathematicians and electronics engineers--the organization for the process of task solving and eliminating nonproductive losses of working time, the data processing technology, the technological algorithms and programs used, the volume of data processed in task solving, and the introduction of new tasks.

In our office increasing efficiency in the use of the computer is effected using all these factors. We think that only in this way is it possible to achieve maximum effect from the operation of electronic equipment.

Improving the quality of work done by servicing personnel and improving the technology for data processing lead to reduced time taken to solve tasks, and this promotes a reduction in the computer load, expressed in hours. The introduction of new tasks leads to increased computer load in hours directly proportional to the time taken to solve the introduced task. Increasing the volume of data processed also increases computer load in hours.

Task solving is made up of several technologic processes: data input, checking, machine processing and printout of results. The time taken to input data is proportional to the amount of data inputted. Properly speaking, time taken for machine processing depends on the volume of data processed, but this dependence is not directly proportional. Time taken for internal machine data processing depends largely on the makeup of the data. If a large volume of data is spread between a small number of establishments serviced, time taken to process 1,000 documents will be the same; if the same amount of data is spread between a larger number of establishments, time taken to process 1,000 documents will be greater.

The prevailing opinion is that the time taken to print results is directly proportional to the amount of data processed. However, the dependence of time taken on the amount of data processed is complex. For example, after tasks for the "operational day" have been solved, various kinds of output are printed and the time taken for this varies: thus, time taken to print individual accounts is almost proportional to amount of data processed. We analyzed task solving for the "operational day" for 16, 17 and 18 June 1980. On these days data on 45 Gosbank establishments was processed. Solving was done by the same person. Equipment functioned normally. Only the amount of data affected production time; the amount of data was different on all 3 days, at 49,500, 28,600 and 33,600 documents respectively. Time taken (in minutes) to input the data varied between 87 and 113; print time for individual accounts varied between 85 and 118; internal machine processing varied between 149 and 193. Total time taken for 1,000 documents was 12.4, 16.4 and 15.5 minutes respectively, that is, the more documents processed, the less the time taken to process 1,000 documents, and the fewer the documents processed the greater the time taken to process 1,000 documents.

The indicator for total processing of documents is a realistic and obvious one for computer utilization. Improving this indicator depends on the input for servicing from other Gosbank establishments, the introduction of new tasks and increases in the volume of data processed in the tasks solved.

Questions of improving efficiency in the use of the computer have always been at the center of attention in the Voronezhskaya Oblast Gosbank office computer center. From the very first days of on-line operations at the computer center the target was set of maximum load on the computer, both in terms of hours per day and the volume of data processed. With this end in view it was decided to service the maximum possible number of Gosbank establishments in Voronezh and Voroneshskaya Oblast. At the same time, anothe task was set--to introduce the largest possible number of tasks to be handled by the computer so that all operations involving mechanized processing of bank data could be transferred to the computer.

To achieve the goals that had been set a great amount of organizational work was carried out, in three stages.

The first stage was the transfer of nine Gosbank sections located in Voronezh to computer servicing. The second was the transfer to computer center servicing the out-of-town Gosbank sections whose data was being processed at a mechanized accounting office. The third stage was to seek out possibilities for transfering to computer center servicing the out-of-town Gosbank establishments whose data was hand processed.

The need to space the work in stages resulted from the technologic features involved in the transmission of input data to the computer center and the inadequate training of bank workers for operations with mechanically processed data.

The transfer of the Voronezh city Gosbank establishments to computer center servicing did not cause any special difficulties. In accordance with the plan drawn up, all the out-of-town establishments had to be transferred to computer center servicing during the period ending 1 May 1976. In fact, we completed this work by 1 April, that is, 1 month early.

The transfer of out-of-town banking establishments was fraught with great difficulties. Before the transfer to the computer center, data from six out-of-town establishments were being processed at the Voronezh Mechanized Accounting Office, with three of them passing data via dedicated telegraph channels and three delivering documents to the accounting office where data was transferred to punch cards. It was necessary to resolve the question of handling communications with leased dedicated telegraph channels. Telegraph equipment was needed for each Gosbank establishment accepted for computer center servicing--a minimum of three sets of equipment. In addition, at each Gosbank establishment it was necessary to equip the telegraph sections and train bank workers in data transmission methods and the operation of telegraph equipment.

By the beginning of November we were using leased dedicated telegraph channels to service seven out-of-town bank establishments. We started to look at the possibility of taking on additional establishments for servicing and concluded

that this was possible, using the USSR Ministry fo Communications subscriber telegraph system. Automatic teleprinter exchange equipment has been installed in many bank establishments. In the regional Gosbank offices they are used during regular hours and the traffic is not very heavy. After conducting several test data transmissions from the Gosbank sections to the computer center using subscriber telegraph we concluded that it was possible to use the automatic teleprinter exchange equipment to transmit data to the computer center.

In July 1976 we introduced the task "comprehensive interbranch circulation acknowledgement" and in November 1976 the "interbranch circulation control." Thus, since November 1976 all data processing has been transferred to the computer and the laod on the computer equipment has thereby been significantly increased.

It can be asserted on the basis of our experience that it is possible to transfer an average of 10 to 12 establishments each year to computer center servicing.

From the fourth quarter of 1976 through the fourth quarter of 1979, that is, in a 3-year period, the number of Gosbank establishments serviced increased by a factor of 2.4 and the volume of data processed during this period doubled. However, the increase in the volume of data processed lagged slightly behind the increase in the number of establishments serviced. This indicates that the out-of-town establishments subsequently accepted for servicing produced generated on the average a smaller amount of data. But this difference is insignificant; the two indicators grew almost in parallel.

Time taken to handle tasks for the "operational day" per 24 hours or computer load in hours remained at virtually the same level: in the fourth quarter of 1976 it was 8.6 hours, and in the fourth quarter of 1979 it was 9.7 hours. Time taken to process 1,000 documents was halved. These two indicators characterize as a set the efficiency in the computer operation when handling the "operational day" task.

It is frequently thought that the main criterion for efficiency in computer operations lies in releasing administrative and management workers.

In fact, when the computer center was set up at the Voronezhskaya Oblast Gosbank office there was no reduction in the staff but on the contrary, some increase. Should we think from this that the creation of the computer center did not produce the required effect? Of course not. According to our calculations, the work done by the computer center nominally reduced the apparatus by more than 120 persons. Our calculation was based on the fact that, in our opinion, within the Gosbank establishments there is a relatively hidden shortage of personnel in the apparatus, compensated for by the stress in the work of bank officials and partial overtime working. With the aid of the computer center, this overtime work and stress are eliminated in the establishments serviced. Data processing in the computer center has promoted an acceleration in the rate of turnover of assets in the accounts handled by Gosbank.

The advantage of the automated system lies primarily in the fact that the quality of function in the object controlled is considerably higher. Improvements in working conditions, the change in the nature of the work, the reduced stress on working personnel in the Gosbank establishments serviced and the accelerated rate of turnover for assets, it seems to us, are also relevant to improvements in management.

The computer center at the Voronezhskaya Oblast Gosbank office now processes four times the amount of data than was earlier processed at the mechanized accounting office, and, indeed, at the time when the computer center was set up, the opportunities for increasing the volume of work at the office were completely exhausted. It should also be taken into account that many of the kinds of operations performed by the computer center were impossible at the accounting office.

Since November 1976 the task "interbranch circulation control" has been handled on the computer. Increasing the group of interbranch circulation for control has made it possible to significantly improve the indicator for computer efficiency in all aspects. First, we process punch cards in the computer without an additional increase in staff operating the computer, and the volume of documents processed for this task has increased substantially. The daily average computer time for handling this task is 2.9 hours. It takes 12.8 minutes to process 1,000 documents, which is much less than when they are processed on accounting machines. Second, we obtain considerable loading of the computer in time. Third, because the mechanized accounting offices in the cities of Kursk, Tula, Kaluga and Orel have stopped doing this work they are able to service additional numbers of Gosbank establishments, and the percentage of intragroup processing has grown.

Computer centers are now carrying out a great deal of work to substantially change the technology used to transmit and check data; the method whereby data are transmitted via an intermediate data carrier with subsequent manual checking for errors is being replaced by a method whereby data are inputted directly from the communications channels into the computer, that is, data transmission is effected in an OPERATOR-COMPUTER dialogue mode.

Introduction of the direct method for inputting data to the computer together with the elimination of manual checking of data have made it possible to release the economists engaged in hand checking of data and switch them to other work; and have also provided the opportunity for taking on the servicing of new bank establishments without hindrance, up to the number allowed by the program.

The following matter is also worthy of attention. In our opinion, it would be well to set up computer centers in the centers of economic regions. In this regard, we think that the computer center at the Voronezhskaya Oblast Gosbank office is sited in a fortunate location. Voronezh city is the center of the Central-Chernozem economic region. The region includes Voronezhskaya, Kurskaya, Belgorodskaya, Lipetskaya and Tambovskaya oblasts. And in the future the computer center will be serving Gosbank establishments in all five of these oblasts. This will make it possible to create an objective base (all other things being equal) for efficient computer utilization.

The leadership of the computer centers should be mentioned. The RSFSR Gosbank office has set targets for the computer centers on RSFSR territory to transfer to the servicing of new establishments. But the target has been set without being broken down by offices. As a result, the computer center does not know which offices have been earmarked as serviced offices in the preparation and transfer plan. No such plan has been set for the offices to be serviced. And so, the task for transferring to the servicing of new establishments is set for

the computer center. But in order to prepare for and transfer to servicing for a Gosbank establishment the computer centers must do a great deal of painstaking preparatory work, and much efforts is needed on the part of the computer center, the Gosbank office and the establishment being prepared for transfer. And given the existing practice in setting targets, this work and responsibility are being laid on the computer center. At the same time, it is not clear from what considerations plans are being set for the transfer of new establishments to servicing. In our opinion, the target should be set by offices and passed on to the appropriate offices so that each office as well as the computer center would have an interest in the transfer of new establishments to servicing.

The comprehensive resolution of technical support for the operation of computer centers plays an imprtant role in improving efficiency in computer utilization. We have set up an entire network of computer centers equipped with powerful and expensive computers. This work was also done rather quickly at the planning level. Software operations for working complexes are proceeding quite satisfactorily. But the provision of working centers with communications, that is, dedicated telegraph channels to the Gosbank establishments transferred to servicing, remains inadequate.

The following also reduces the effect of computer operations. Our computer center produces advice notes for initial interbranch circulation only for nine Gosbank establishments in Voronezh. For the rest of the establishments serviced the advice notes are prepared, as before, manually on typewriters. This happens because in accordance with existing instructions advice notices from Gosbank establishments must be put in the mail on the day that transaction are completed in individual accounts, while as a rule they cannot be sent on the same day from the computer center to the out-of-town establishments.

Up to now, work on bookkeeping operations has been mainly mechanized with the aid of the computer. Of course, this is as it should be, since bookkeeping operations are the most massive but homogenous and lend themselves readily to mechanization and automation. The further introduction of work for the economic apparatus would be a substantial moment in improving computer efficiency.

9642
CSO: 1863/87

ELEKTROMASH PRODUCTION ASSOCIATION

Kiev PRAVDA UKRAINY in Russian 26 Jan 82 p 3

[RATAU report]

[Excerpt] Creative contacts have for a long time linked the collectives of scientists at the Ukrainian Academy of Sciences Institute of Cybernetics and the workers at the "Elektronmash" Production Association. At this enterprise they produce the "Mir" and "Dnepr" computers and other equipment developed by the Kiev cyberneticists. Close cooperation has helped in solving many of the complex problems facing the sector.

Ways of further expanding links and accelerating the practical realization of scientific developments were the subject of an interesting and businesslike talk during the creative accounting report of the scientists at "Elektronmash" which took place within the framework of a republic survey on the introduction of scientific achievements in production.

Corresponding member of the Ukrainian Academy of Sciences B.N. Malinovskiy, department chief at the institute, and his colleagues told the enterprise workers about the directions of the research being done by the cyberneticists, the development of new, high-speed machines and microprocessors and other equipment, and the plans for the 11th Five-Year Plan. In their turn, S.S. Zabara, deputy general director at the association, and other sepcialists provided information on progress in introducing the scientists' development at "Elektronmash," and about the tasks and production problems facing the enterprise workers.

In the workshops and cybernetics sections they familiarized themselves with the production of alphanumeric printers, the operation of the assembly-and-installation lines, and the process of debugging a new microcomputer. The partners outlined directions for further joint work and a range of questions on whose resolution attention should be primarily concentrated.

"These kinds of meetings are very useful both for the scientists and the production workers," said A.V. Mironenko, the party committee secretary at the association. "For of course, the better we know each other's needs the easier it is to develop and introduce new equipment in the national economy. During the past 15 years 17 designations of computers have been assimilated at our enterprise. It is clear that without the help of the various institutes in the country, we would not have been able to do this in such a relatively short time."

9642
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METHOD OF MEASURING COMPUTER LOAD IN MULTIPROGRAMMING REAL-TIME DISK OPERATING SYSTEMS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
(manuscript received 2 Dec 80, after revision 26 Mar 81)
pp 22-23

[Article by Al'bert Aleksandrovich Batner, engineer, Vladimir Ivanovich Krivov, engineer, and Mikhail Georgiyevich Logunov, engineer, IPU of the USSR Academy of Sciences, Moscow]

[Excerpts] The multiprogramming real-time disk operating system (DOS RV) implemented on the minicomputers M6000, M7000, SM-1 and SM-2 does not have systems means for determining the load of the computer processor or the input-output devices. Below, a description is presented of a simple method permitting estimation of the processor load by applied programs (including the time spent by the operating system on servicing them) without altering the operating system or the hardware.

The load is measured by a special program, operation of which reduces to increasing the value of a counter from a given negative value to zero and determination of the time required for this (not the processor time, but real time). This program has lower priority than any applied program operating in the system; therefore it will be executed only when the processor is free; consequently, the time of filling the counter characterizes the free time of the processor.

In the DOS RV the ready-access memory used for locating the programs is usually divided into two basic regions: the real-time program region and the background program region; therefore the procedure for using the measuring program can differ. For example, if the analyzed applied program does not have background disk-resident programs (which occurs quite frequently), it is possible to locate the measuring program which indicates the use of the processor by this system in this region. If the measuring program is located in the disk-resident real-time program region, then the losses to replacement of the disk-resident programs in the ready-access memory (swopping) are taken into account.

10845
CSO: 1863/60

HARDWARE

NEW HIGH-SPEED PRINTER GOES INTO PRODUCTION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 20 Jan 82 p 2

[Report by correspondent Yu. Antropov, Kursk: "A Fast 'Tab'"]

[Text] The interdepartmental commission has accepted the country's first input-output printer capable of handling data automatically both directly from a computer and from various carriers (punch tape and magnetic tape and magnetic disks). It is distinguished by its high operating speed--up to 30 characters per second, which significantly increases the possibilities of the computer (up to now, a lever device with an operating speed of 7 characters per second, purchased from abroad, has been used).

The basis of the high operating speed is the so-called tab disk which has replaced the traditional levers with letters. The entire standard set of letters, numbers and characters, 102 positions in all, is placed on the beam of the "tab." If print in another language is required, it is necessary only to change the "tab," which takes about 30 seconds.

The tab device has been developed by the creative collective of the special design bureau for printing machines (chief: B.N. Kozhevnikov) in a very short period of time--just 7 months. This year a group of plants belonging to the Ministry of Instrument Making, Automation Equipment, and Control Systems are to manufacture the first batch of 500 devices. This will be followed by large-series production.

9642
CSO: 1863/85

NEW UNITS FOR UNIFIED SYSTEM OF COMPUTERS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81 pp 131-134

[Article by Anatoliy Anatol'yevich Shelikhov, engineer, Scientific Research Center for Electronic Computer Equipment, Moscow]

[Text] YeS3267 On-Line Memory

The YeS3267 on-line memory is designed for use in the YeS1045.01 computer as the basic core memory and is used for information storage, reception and transmission.

Structurally, the one megabyte on-line memory together with the feed system is placed in one standard frame. On the YeS1045.01 computer it is possible to build up the on-line memory to four megabyte by putting three megabytes in the standard YeS3267.02 frame and one megabyte in a combination rack frame.

The memory modules are construced from the series 565 RU1B microcircuits. The presence of hardware to check the address and information circuits and correct the binary errors as a result of time redundancy and also a highly reliable element base have improved the operating indices of this unit.

Technical specifications

Capacity	1 to 4 megabytes
Cycle	720 nanoseconds
Access time	650 nanoseconds
Word length	16 bytes
Intake power	0.8 kilovolt-amperes
Overall dimensions of a 1 megabyte on-line memory	1028 × 280 × 1490 mm
Weight of the on-line memory per megabyte	250 kg

YeS7018 Punchcard Output Unit

This unit is designed to output information transmitted from the computer channel in the form of electric signals on 80-column punchcards. It is connected by means of the standard input-output interface to models of the unified system of computers through a multiplex channel, and it operates in the multiplex or exclusive mode.

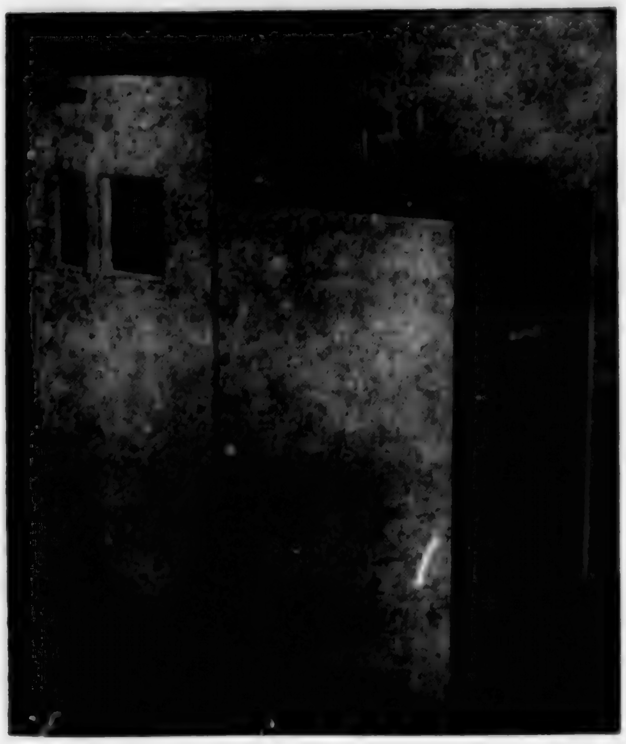
Information from the channel is entered in a memory element with a capacity of two punchcards, and it is punched on the card. The device receives information from the computer by columns, and the punching is done by positions.

In the device a system has been provided to shut off power if the feed network voltage disappears, there are no output voltages, there is a short circuit or the voltage of the secondary power supplies is exceeded. The information is output to the punchcards with hardware conversion of the KDOI code to KPK-12 code and without hardware conversion (in any code). The choice of operating conditions is determined by the instruction code.

The unit identifies its state by sending the state byte and four sensing bytes to the computer channel.

Technical specifications

Output speed	100 cards/minute
Hopper capacity:	
feed	no less than 700 cards
receiving	no less than 600 cards
Feed	380/220 volts; 50 hertz
Intake power	1.2 kilovolta amperes
Overall dimensions	1200 × 550 × 1230 mm
Weight	380 kg



YeS7036 Alphanumeric Printer

The YeS736 alphanumeric printer is designed to print out alphanumeric information output from the unified system computer channel. The information can be represented in the form of numbers, text, tables and graphs.

The unit provides line-by-line printout and movement of the paper tape under instruction control and by orders issued by the multiplex or selector channel of the computer. The data for printing a line are transmitted to the unit in individual bytes and stored in a buffer memory, the capacity of which is one line. The speed of arrival of the data is not critical, the normal operating conditions are insured with a data exchange frequency to 250K bytes/sec.

The paper shift is controlled by two methods:

the amount of line skip is given by instructions;

in accordance with the previously established format.

Accordian-folded perforated paper (80-420 mm) is used as the information carrier.

In the unit a diagnostic program is provided for the buffer storages and electromechanical assemblies. This diagnostics program is executed by diagnostic write-read instructions and six sensing bytes.

The ATsPU [alphanumeric printer] YeS7036 has improved operating indices as a result of the following:

the possibility of autonomous checking of the on-line memory;

electronic control of the printing of a line with respect to fixed lines on the form;

adjustment of brightness and print time of the symbols;

introduction of an electronic print protection cycle;

introduction of control functions for running out of paper or tearing the paper, loss of paper as a result of programming or a failure of the printer, movement of the paper tape, the operating position of the type carrier, and so on.

Technical specifications

Print speed	800 lines/min
Number of characters per line	132
Size of printed symbols	2.3 × 1.4 mm
Space between lines	4.23 mm
Number of copies	up to 6
Power supply	380/220 volts; 50 hertz
Intake power	no more than 1.5 kv-amp
Overall size	1383 × 701 × 1200 mm
Weight	420 kg

YeS7040 Printer

This printer is designed to print out alphanumeric information on computers of the unified system. The printer provides for line-by-line printing with subsequent shifting of the perforated paper tape (80-420 mm) under the control of instructions and orders given by the computer channel. Up to four copies can be obtained on special paper. Printing is done by the parallel method.

The presence of a buffer memory with one line capacity permits a wide range of data arrival frequencies in the printer (maximum 150 K bytes/sec). The data for printing a line are transmitted to the device in separate bytes and stored in a buffer memory. On completion of transmission of the data, the information in the buffer memory is printed out.

The paper carrier is shifted by two methods:

assignment in the instruction of the amount of line skip reckoned from the current position of the paper tape;

in accordance with a previously established format.

If necessary the operator can control the operating mode of the printer from the operator panel: set the beginning of the form in the print position, advance the paper the required number of lines, and so on.

In the printer provision is made for control functions of the end of the paper tape or a tear in the paper tape, damage to the perforations of the paper carrier, the operating position of the symbol drum, runaway of the symbol drum motor, and so on. A parity check is made on the information coming from the computer, and unacceptable symbol codes are detected.

Technical specifications

Print speed	no less than 400 lines/min
Number of characters per line	132
Number of printed symbols	84
Size of printed symbols	2.3 × 1.4 mm
Space between lines	4.23 mm
Feed	220 volts; 50 hertz
Intake power	no more than 0.8 kilovolt-amp
Overall dimensions	876 × 860 × 1084 mm
Weight	no more than 250 kg

Graphical Data Group Input-Output Unit YeS7905

This unit is designed for input-output of alphanumeric and graphical data on a cathode-ray tube during real-time machine design.

As a peripheral device, the YeS7905 is connected to the selector or multiplex channel of computers of the unified system. The YeS7905 operates under the control of the operating system of the unified system. The information is processed by means of internal programs of the unit.

The YeS7905 includes the YeS7565 control unit and YeS7065 screens (up to four of them).

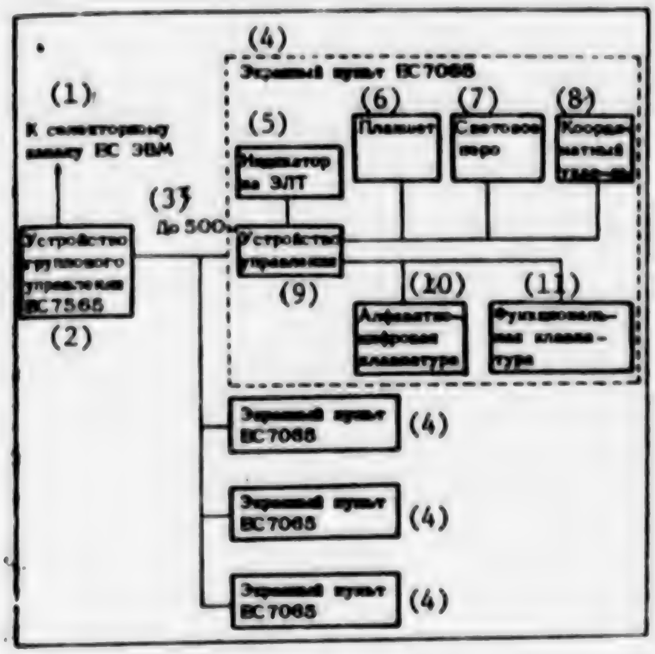
The YeS7565 control unit provides direct communications with the computer and also storage, processing and output of information for four of the YeS7065 screens (see the diagram).

The YeS7065 screen is the operator work place and provides for the formatting and screen display of graphical and symbolic information, and it also provides input and correction of symbolic data using a keyboard, input and correction of graphical data using a plotting board, light pencil and coordinate indicator. The maximum distance of the screen from the control unit is 500 meters.

Technical specifications

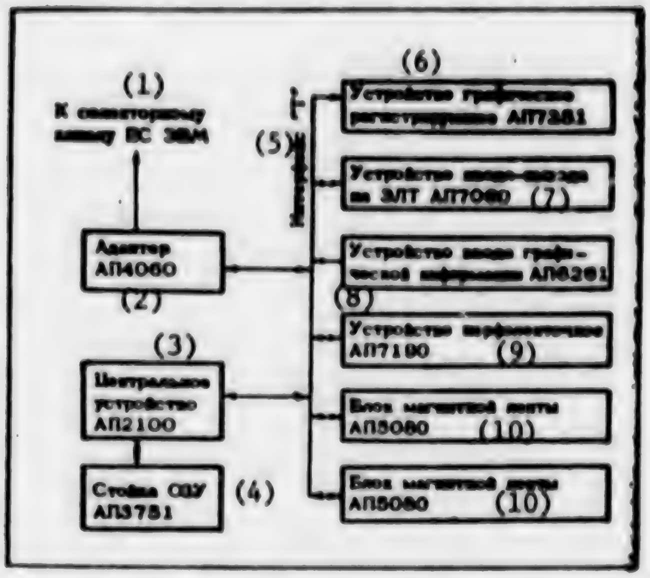
Size of the working field of the screen	250 × 250 mm
Number of output symbols	96
Method of forming the symbols	in segments
Number of symbols in a line:	
basic size	74
enlarged size	49

Maximum number of symbols on the screen (without flickering)	2100
Number of output vectors of length:	
16 spacing units	1490-2720
64 spacing units	1920
1024 spacing units	250
Dimensions of the plotting board work field	400 × 400 mm
Overall dimensions:	
YeS7565 control unit	1200 × 750 × 1050 mm
screen YeS7065	1385 × 909 × 1125 mm
Intake power	no more than 4.2 kilovolt-amps
Weight:	
YeS7565 control unit	380 kg
YeS7065 screen	300 kg



Block diagram of a group graphical data input-output unit YeS7905

Key:
1. to the selector channel of the unified system of computers
2. group control unit YeS7565
3. up to 500 meters
4. YeS7065 screen
5. cathode-ray tube display
6. plotting board
7. light pencil
8. coordinate indicator
9. control unit
10. alphanumeric keyboard
11. functional keyboard



Set of graphical data input-output units YeS7908

Key:
1. to the selector channel of the unified system of computers
2. adapter AP4060
3. central device . AP2100
4. on-line memory rack AP3751
5. interface T
6. graphical recorder AP7251
7. cathode ray tube input-output unit AP7060
8. graphical data input unit AP6261
9. tape punch AP7190
10. magnetic tape module AP5080

Graphical Data Input-Output Unit Complex YeS7908

This complex is designed for graphical data input, output and processing when working with computers of the unified system and autonomously.

The graphical data input process to the computer using the YeS7908 complex includes several steps:

preliminary operation with the information carriers with respect to converting the graphical data to digital form;

program processing of the digital data;

input of digital data to the computer for further processing of it by the user algorithms.

In the graphical data input mode the operator has the possibility of visual monitoring of its operations, editing of the information and correcting errors. The check outlining of the drawing fragments on the screen is the last step before sending information to the computer for subsequent processing.

Output of the summary results to the computer is preceded by digital data transmission in a defined format, data processing and also drawing up the graphical data.

The YeS7908 complex provides for the following operating modes:

graphical data input by blocks and files;

drawing up the data arriving in blocks from the computer;

accumulation of data on a magnetic carrier and subsequent drawing it up;

drawing up the data from a punchtape in ISO format or the unified system of computers codes.

Provision is made for copying the data from punchtape on magnetic tape and back and also conversion of the formats of the data written on punchtape.

The software of the YeS7908 complex includes the following: the operating system, the programs developed specially for the complex, translator from the language of the computer data format to the data format of the AP7251 plotter, test programs, check tests, and so on.

Provision is made for the possibility of building up the software for solution of applied user problems.

The composition of the YeS7908 complex (standard) is as follows:

AP2100 central device;

AP3751 on-line memory;

AP5080 magnetic tape module (2);

AS7251 graphical recorder;

AP6261 graphical data input unit;

AP7060 cathode-ray tube input-output unit;

AP7190 tape punch;

adaptor AP4060.

Technical specifications

Data carrier	
in the input mode	paper or film no more than 1 mm thick
in the output mode	cartographic or coordinate scale paper
Working field	1189 × 841 mm

Maximum speed of moving the viewer along each coordinate (input mode)	300 mm/sec
Node point coordinate read speed (input mode)	no less than 10 points/min
Maximum speed of drawing vertical and horizontal lines with spacing of 0.05 mm (output mode)	no less than 100 mm/sec
Line thickness	0.8, 0.6, 0.3 mm
Number of writing units	3
Minimum spacing	0.05 or 0.025 mm
Feed	380/22 volts; 50 hertz
Intake power	no more than 3 kilovolt-amp
Required floor space	no more than 30 square meters

10845
CSO: 1863/60

PROTOTYPE YeS-1036 COMPUTER DEVELOPED

Minsk SOVETSKAYA BELORUSSIYA in Russian 10 Nov 81 p 1

[Article by G. Kotov: "The Numbers of Computers Have Increased"]

[Text] A prototype of the new YeS-1036 computer has been delivered to the NII EVM (Scientific Research Institute of Electronic Computing Machines) for debugging a month ahead of schedule.

A group of specialists is having a lively discussion on the quality that has gone into building the heart of the machine -- the control console. Included here are the chief designer of the YeS-1036 computer, Ruben Mikhayalovich Astsaturov, deputy chief designer Aleksandr Petrovich Zapol'skiy and mechanical foreman Yevgeniy Petrovich Gamshey.

The designers are satisfied: their plans have all been incorporated. The most important stage -- the birth of the computer -- occurs here, in the experimental plant of the Institute. The process is rather complicated. The 36 model uses thousands of different kinds of microcircuits, and the computer "thinks" and "talks" with people.

Everyone who participated in building the prototype exhibited creative initiative and inventiveness. The main load was borne by the fabrication section collective headed by communist Leonid Konstantinovich Snyatovich. The installers held up their end as well. The mechanical crew headed by Gamshey were reliable co-workers. This collective was organized especially to build the prototype of the new computer model. Experienced technicians were selected. Vladimir Vladimirovich Imbra, Ivan Ivanovich Obmetko, Anatoliy Antonovich Puchinskiy, as well as the foreman himself, are experienced technicians who work by warrant of the technical monitoring department. These individuals executed the initial and final operations involved in assembling the modules and the computer. During creation of the YeS-1036 computer, the collective of the institute responded to the initiative of deleting Minsk collectives in specific matters: "High quality of development and fabrication for each article in the union of science and production".

The laboratories of the Institute are "teaching" the new computer to interact with man.

Here is the commentary of Aleksandr Petrovich Zapol'skiy, deputy chief designer of the YeS-1036 computer:

-- This new model will reach the production line of the Minsk Computer Technology Production Association next year. It represents a significant modernization of the YeS-1035 computer which that enterprise is now producing. The new computer is a step ahead from the second generation of computers to the third.

The goal during development was to improve the technical and economic characteristics of the machine. We tried to create a more efficient model and to make sure that the amount of labor required would not exceed that for the "35". The designers used modern technical innovations.

What is the difference between the new computer and its predecessors? First of all, its efficiency. The computational speed is more than twice as great. Under defined conditions the speed can even be greater in solving certain problems. The memory capacity of the machine has been quadrupled. The throughput capacity of the communications devices of the main element of the machine -- the processor -- with the peripheral devices has been increased significantly.

The machine provides the capability of microdiagnostics, i.e., it can use special programs to find the cause of various faults, and immediately informs the operators.

I would like to point out another innovation used in creating the computer. Many of the devices were designed with computer assistance. The computer used instructions to solve problems for the designers automatically, and output finished documents.

The family of Belorussian computers has thus received a worthy addition.

6900
CSO: 1863/65

NEW SHARED-RESOURCE COMPUTER CENTER IN STAVROPOL'

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 2 Dec 81 p 1

[Article by N. Lozdovskaya, deputy chief of Kray Statistical Directorate Computer Center, Stavropol': "A Problem with Two ... Knowns"]

[Text] It has been decided to build a completely new shared-resource computer center on a cooperative basis in Stavropolskiy Kray. The main argument for the new construction is to combat dissipation of resources. It cannot be denied that this is a timely slogan, but let us see what is actually going on.

In the Kray center alone, more than 30 institutions and enterprises have developed tasks for management information systems, but there are neither the specialists nor the basis for implementing them. The requirement of these organizations for computer time is between 30 and 40 hours daily and growing. This requirement, however, is not satisfied at the expense of a heavy work load for existing computer centers, but rather by building a center for each organization. During the 10th Five-Year Plan, almost twice as many of these "personal" centers were built than in the 9th: there are now 89 of them. The machine work load is dropping from year to year, now comprising 60% of the standard.

A sufficiently powerful center now exists in Stavropol' which could act as a base center. This facility belongs to the Kray Statistical Directorate, and it was originally formed as a shared-resource center. The absolute majority of work is executed according to management agreement and it serves about 100 organizations.

Might not the computer center of the Kray Statistical Directorate provide a suitable framework for the creation of a "Kray management information system"? The answer is no: government statistics are the main source of information for all planning and administrative organs.

The main components of a regional management information system are the automated planning calculation system and the automated government statistics feedback system. The latter has already been implemented at the Kray Statistical Directorate computer center. Both of these systems use basically the same group

of economic indicators. The problems of the systems are tightly interwoven and supplement one another. The technical plans are interconnected as well.

Of course, there is no point in posing the problem of combining similar systems on a national scale, but it might be possible to create a data base on the Kray scale for them on a single information and technical base. This will make it possible to solve most problems in an integrated fashion during system development, thus significantly curtailing expenses for data base maintenance during operation.

Of course, it is pointless to reorganize any statistical directorate computer center to a shared-resource center without re-equipping it and expanding its size. However, reconstruction is cheaper than new construction, costing about half as much according to calculations. It will take years for a new center to be developed, the staff to be built up, the technical data processing procedures to be dubugged, a portfolio of orders to be accumulated, and production to begin.

We have heard it expressed that statistics are not useful for developing large-scale regional problems. But is this the case? Cooperating by management agreements with enterprises in Leningrad and Nikolayev and obtaining scientific and methodological support from their scientific-research subdivisions, the computer center of the Kray Statistical Directorate is successfully executing such complicated tasks as development of enterprise and branch models.

The departmental subordination of statisticians also does not hinder the creation of a regional management information system. Most of their work is now being done for enterprises and organizations of the national economy. The constuction of a new seemingly independent center places a bureaucratic fence between the already existing "Kray management information system" subsystems.

6900
CSO: 1863/65

ARRIVAL OF EL'BRUS EXPECTED

Tallinn SOVETSKAYA ESTONIYA in Russian 16 Dec 81 p 2

[Article by A. Favorskaya: "Each Estonian Computer Scientist Pursues a Topic Which Will Contribute to Science"]

[Excerpts] Ants Vyrk showed us around the new building, full of light and air, with noticeable pride. It is true that not everything here had been made fully habitable. Behind the transparent glass wall of one of the halls, there was a pile of ordinary wooden boxes, still not unpacked. "El'brus", said Vyrk, nodding at this pyramid. He was not referring to its height, but to the face that inside the boxes were the units of the "El'brus-1" computer, which will be set up here when the whole complex is fully assembled.

For the time being, there are not many "El'brus's" in the nation, and this is the first in our republic. Using this computer as the basis, the Cybernetics Institute of the Estonian SSR Academy of Sciences will create a collective use computer system for academic institutions. And the unusual building where we now are was designed and built especially for this system.

One immediately notices that, although there are no windows in the machine rooms (a computer likes a constant temperature and won't tolerate drafts), one feels here as if one is outdoors (conditioning!). The rooms have powerful vacuum air filtration systems. There is a special, particularly clean, stall for repair and maintenance of the computer's peripheral storage units. Response in case of fire is fully automatic: the flow of air is cut off to prevent the fire from spreading and smoke is sucked out of the room. All these complex maintenance systems--their cables, apparatus, pumps are not visible on the surface, they have been installed in a special zone.

When, several years ago, it was decided in high places to give one of the still rare "El'brus's" to Tallinn, this was not an advance payment in expectation of future benefits. The fact was that the Cybernetics Institute was already firmly established as one of the nation's leading collectives in systems programming and development and application of new devices of computer technology.

For machines of the "Minsk" type, the Institute created high level programming languages which themselves performed a good portion of the programmer's work. These are MALGOL and VELGOL. They have already been used in our nation for 10-15 years for the solution of technical and economic problems. And the Institute's role in their creation is recorded, among other places, in their very names: the first syllables of these languages - MAL and VEL - come from the first names of their creators - Malle (Kotli) and Vello (Kuuzika).

Through the transparent partition in the rooms, "El'brus" will see its vis a vis, the YeS EVM (Unified System Computer) - 1052.

By pressing a button on the display, you can, if necessary, immediately correct, further specify or modify something. Here they are, these displays on the table. They look like television sets, only with keyboards. There are already 16 of them and by the end of the year, there will be 20. They will be set up right in the users' offices, in the building which will be built next door for the Institute. And they hope to also obtain displays with telephone hook-ups, so that the computer can be used at greater distances.

In the computer technology sector, headed by Arnol'd Reytsakas (now, an Honored Engineer of the ESSR), each person was alone with "his own topic". One person was adjusting the curve plotter of the new computer - a table with a recorder, capable of making any drawing and writing captions on it at sixteen angles. In one of the rooms, chalk could be heard on the blackboard: Rayvo Kasemaa, who had worked for three years as a programmer for the Soviet-Finnish firm of "ELORG-DATA", was sharing his experiences, giving a seminar in improving dispatcher service to clients.

9285
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IZOT 1002 C WORD PROCESSOR

Kiev MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 4, Oct-Dec 81 outside back cover

[Text of advertisement for the ISOTIMPEX IZOT 1002 C word processor]

[Text] The IZOT 1002 C word-processing system is designed for automation of work in typing bureaus, editorial offices and polygraphy concerns, and for document compilation for new articles in planning-and-design institutes and also for organizing up-to-date office activities in large industrial and agricultural associations.

The IZOT 1002 C is available in the form of two standard mechanized modules. It incorporates a control device based on an 8-bit microprocessor, a YeS-7187 series-produced alphanumeric printer and external storage using YeS-5074 magnetic disks.

Technical features:

Storage: 48K
CRT display: 1,920 symbols
Keyboard:
- standard: Cyrillic and Latin
- functional: based on traditional language for text correction and editing

Power supply: 220V at 50 hertz

The functional operations of the IZOT 1002 C are as follows: input and recording of text in storage, automatic presentation of text format, various kinds of error correction (insertion, replacement and deletion of sentences, words and individual symbols), compilation of documents from standard sentences, producing copies of documets.

Exporter: "IZOTIMPEX" Foreign Trade Organization, Sofia, Bulgaria, ulitsa Chapayeva 51. Telephone 73-61, telex 022731, 022732.

"Vneshtorgreklama" all-union association.

9642
CSO: 1863/84

UDC 681.327

INTERFACES FOR DIFFERENT KINDS OF COMPUTER COMPLEXES USING MICROPROCESSORS

Kiev MEKHANIZATSIYA I AVTOMATIZATSIYA UPRAVLENIYA in Russian No 4, Oct-Dec 81 (manuscript received 1 Jun 81) pp 52-54

[Article by engineers G.M. Inkulinets and I.V. Koryakov, and candidate of technical sciences P.A. Savis'ko]

[Excerpts] When organizing data exchange between territorially separated computer complexes using different equipment, the problem frequently arises of data interfaces between them. This problem is particularly acute in establishing data interfaces between computer complexes already in existence since in this case the introduction of design and software changes entails high costs or is simply impossible.

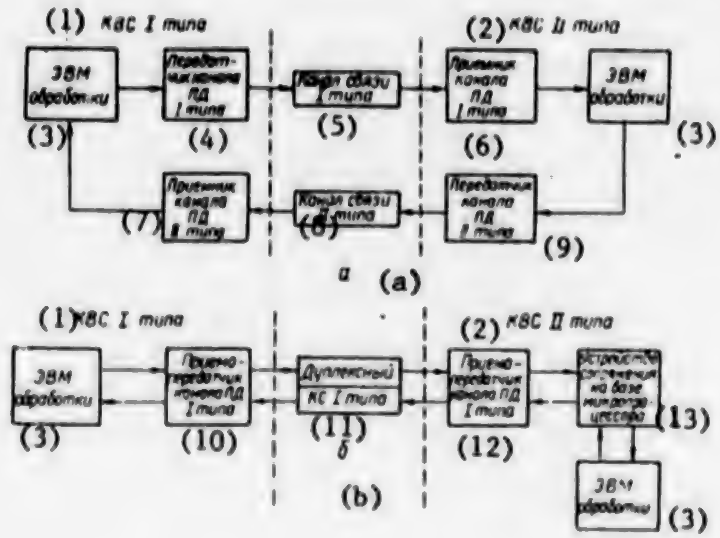
The problem of establishing interfaces between different kinds of computer complexes (that is, computer complexes that differ in the way in which data are presented on control parameters and time characteristics, and also in respect of different operating speeds for data transmission via data transmission channels and the format of data) consists of developing software and equipment that insure the reception of data via type I data transmission channels, and their conversion into the form necessary for processing in the type II computer complex with subsequent input to a computer complex (figure 1a).

This kind of approach to solving interface problems leads to complications in the software and program-logic for the computer and the use of a large part of the computer's processing facilities for unproductive operations connected with the selection and conversion of data from a different kind of computer complex which is not standard for the computer system acquiring the data. Moreover, several data transmission channels are required to organize the exchange, and this complicates both the process of data processing and the operation of the system as a whole.

The use of microprocessors makes it possible to carry out the basic operations of data selection and conversion not in the computer but in a special interface device based on a microprocessor, as shown in figure 1b. Here, it becomes possible to organize exchange between different kinds of computer complexes in such a way as to use the data transmission channel only, for example, for the type I computer complexes. Properly speaking, the interface is hooked in the type II computer complex between the multiplexer for computer exchange and the receive-transmit equipment of the data transmission channel. If the program for converting data in such an interface based on a microprocessor is fully determined by the specific data parameters of the computer complex (length of message, data format, cost of

least significant bit and so forth), then the program for organizing exchange between the data transmission channel, the exchange multiplexer and the microprocessor largely depends on the protocol adopted for exchange and the technical execution of the microprocessor exchange interface.

Figure 1. Versions for Interfaces Between Different Types of Computer Complex



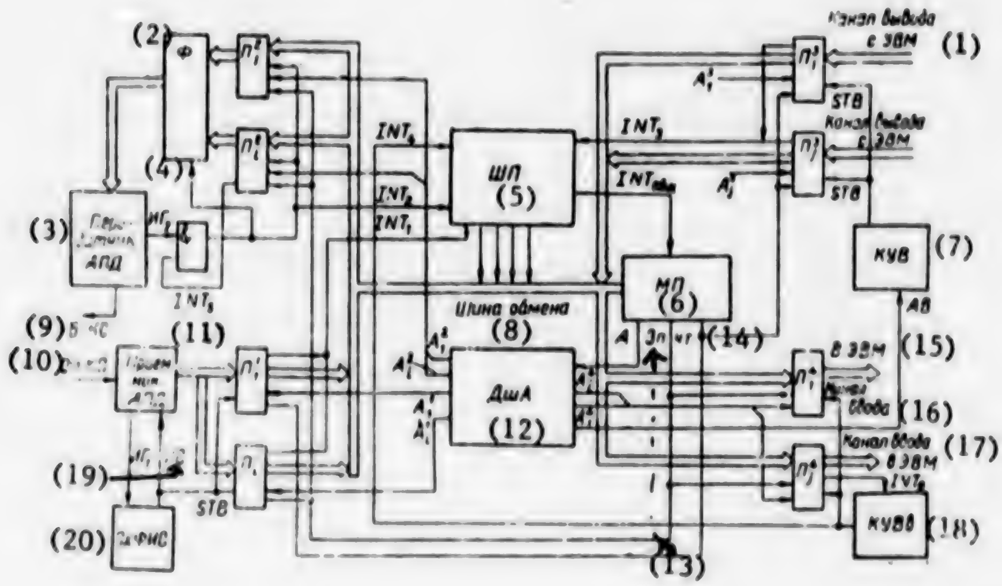
Key:

a. Without microprocessor
b. Using a microprocessor

1. Type I computer complex
2. Type II computer complex
3. Processing computer
4. Type I transmitter for data transmission channel
5. Type I communications channel
6. Type I receiver for data transmission channel
7. Type II receiver for data transmission channel
8. Type II communications channel
9. Type II transmitter for data transmission channel
10. Type I receiver-transmitter for data transmission channel
11. Type I duplex communications channel
12. Type I receiver-transmitter for data transmission channel
13. Microprocessor interface

Below we describe one version of an exchange interface built on the method of program-control exchange and insuring priority processing of data in the microprocessor. A schematic of the interface circuitry is shown in figure 2.

Figure 2. Schematic of Interface Circuitry



Key:

1. Output channel from computer
2. ϕ
3. Transmitter for data transmission device
4. ϕ
5. Priority encoder
6. Microprocessor
7. Output control channel
8. Exchange bus
9. To communications channel
10. From communications channel
11. Rece'ver for data transmission device
12. Decoder A
13. -
14. -
15. To computer
16. Input channel
17. Computer input channel
18. Output control channel (8)
19. Read pulse
20. Read-pulse shaping circuit

The above interface system for linking different kinds of computer complexes was realized on the basis of a K580IK80 single-crystal microprocessor. K589IR12 microcircuits were used as the input-output ports. The system insures linkage between two specialized computer complexes with data transmission speeds of 1,200 and 50 bauds via a 1,200-baud data transmission channel.

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VIRU COMPUTER RUNS GATE TESTER

Tallinn SOVETSKAYA ESTONIYA in Russian 5 Jan 82 p 2

[Unattributed report: "The First in the Country"]

[Excerpt] The country's first automated system for testing power semiconductors for rectifiers has been developed jointly by the specialists from the Tallinn Electrotechnical Plant imeni M.I. Kalinin and the plant scientific research institute with the active participation of collectives from the Estonian Academy of Sciences Institute of Cybernetics Bureau of Computer Equipment and the Leningrad Institute of Railway Transportation Engineers.

Tests showed that the new system can do the work of more than three dozen operators while making about 20 measurements to determine 12 parameters in the semiconductor instruments.

The operation of the unit is controlled by a "VIRU" computer and measurement data are processed by an M-6000 computer.

Results from the testing of the semiconductor rectifiers using the new system are distinguished by their objectivity and high accuracy.

Specialists at the scientific research institute of the Tallinn Electrotechnical Plant imeni M.I. Kalinin are continuing their work on the development of similar test systems for other enterprises in the country.

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DESIGN AUTOMATION AND PRODUCTION PREPARATION SYSTEM FOR PROGRAMMED ROM FOR ELEKTRONIKA 85 MICROCOMPUTERS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81 (manuscript received 17 Jul 80, after revision 19 Feb 81) pp 57-61

[Article by Aleksandr Yevgen'yevich Skvortsov, engineer, Leningrad]

[Text] Introduction

One of the most characteristic features of designing modern computers is the great variety of interrelated problems which must be considered and solved in the design process. Significant and continuous complication of the computer structures, the functions performed by them, the use of the latest achievements of scientific and technical progress in the creation of an element base and the development of the latest technological processes are giving rise to the use of automation media in creating computer design [1].

Accordingly, the problems of constructing systems that automate the processes of development and technological preparation of computer production are acquiring great significance. One of these problems connected with the development of mass production of fourth-generation computers is automation of design and production of programmed ROM [read-only memories] for microcomputers.

The technical and economic characteristics and the structural design of microcomputers determine their broad application in various functional systems, which requires adjustment of the microcomputers to solve specific problems (that is, equipment of the microcomputers with the corresponding applied programs), realization of a defined set of purpose functions. As a result, an original microprocessor system is obtained which is capable of performing information conversions in accordance with the applied program algorithm by means of the microcomputer hardware.

At the present time means of automating software design (system and applied programs) and the hardware production (element base, models of microcomputers) are being developed and introduced. Software complexes have been created and are in operation on universal computers (BESM-6, YeS EVM [unified system of computers], and so on) designed to automate the hardware and software design for microprocessor systems. Here the supplier -- the manufacturer of the microcomputer -- designs and makes the hardware, and the programming is basically done by the customer, for which programming automation systems are set up at the locations where the microprocessor systems are used.

This distribution of functions between supplier and customer is giving rise to the necessity for combining the results of the activity in the phase of physical implementation of microprocessor systems, that is, equipment of microcomputers with functional programs. Accordingly, it is possible to isolate four basic events when making the transition to implementation of the microprocessor system:

design of the set of design documents for a microcomputer for specific application;

design of the manufacturing equipment (intermediate mask) and determination of the method of monitoring the large-scale integrated circuits (LSI) of the programmed IOM;

determination of the method of identifying the program information on all levels of representation of the hierarchy of a microprocessor system;

determination of the rules for interaction of the supplier and the customer.

When developing the microprocessor system based on the "Elektronika S5" microcomputer, equipment with functional programs is connected with programming the ROM based on monocrystalline LSI.

The manufacturing technology for the microprocessor set of LSI of the Elektronika S5 microcomputer imposes significant restrictions on the choice of the method of entering information in the ROM zone. These restrictions determine the use of the programming mask method which combines entering the information with making the microcircuit.

It is natural that under these conditions the problem of creating programmable ROM for microcomputers in the phase of physical implementation of the microprocessor systems must be solved by the manufacturing enterprise which has the required means of producing OSI for ROM, assembling and adjusting the microcomputer. Only the corresponding information about filling the abstract memory zone which is required both for controlling automatic equipment when producing the ROM microcircuits and when assembling the microcomputers is required of the user of the microprocessor system. Hence, it follows that the problem of integrating the development and production of applied microcomputers is connected primarily with solving the procedural problem of transition from program design on the abstract representation level to material representation in the design of the microcomputer.

From the point of view of contract design and production, the development of microprocessor systems means the creation of an original model of microcomputer.

When organizing mass production of microprocessor systems, the transition from abstract programs to their implementation in the form of ROM elements requires that the corresponding information about the program for the ROM determining the program content be included in the contract design. This characteristic must identify the program information on all levels of representation of the structural design of a microcomputer, in all links of the production process when manufacturing it. Considering independence of the design of the microcomputer hardware and software, it is expedient to construct a set of design plans and specifications for microprocessor systems on the basis of the base drawing. The design plans and specifications of the programmed ROM must be considered as production of execution documents. The set of design plans and specifications for the microcomputer set up in this

way permits minimizing the expenditures on document circulation during the design, production and checking of the microprocessor systems.

Direct implementation of interchangeable plans and specifications for a special design of microprocessor systems requires determination of the method of mapping the abstract program memory zone on the physical memory zone and breakdown of the latter into structural elements of the ROM of the base model of the microcomputer. In addition, the preparation and calculation of the plans and specifications are quite labor intensive and fraught with errors of a subjective nature.

It must be noted that when combining a high level of automation of technological processes and variety of process design types of ROM elements (microcircuits, circuit boards), in addition to the design plans and specifications provided for by the YeSKD [unified system of design documentation], the necessity arises for documentation in a form which is directly taken by punchtapes, magnetic tapes and punchcards. Accordingly, the problems of preparing, identifying and accounting for the documentation are acquiring great significance, which puts the development and introduction of automation of these operations on the agenda.

Thus, the problem of transition from program design to "material implementation" of them in the form of LSI and ROM modules reduces to developing an automated system for integration of programming and contract design of ROM having means of receiving, recording, storing and outputting data in the form of the documents needed when ordering, building and checking the corresponding programmed ROM.

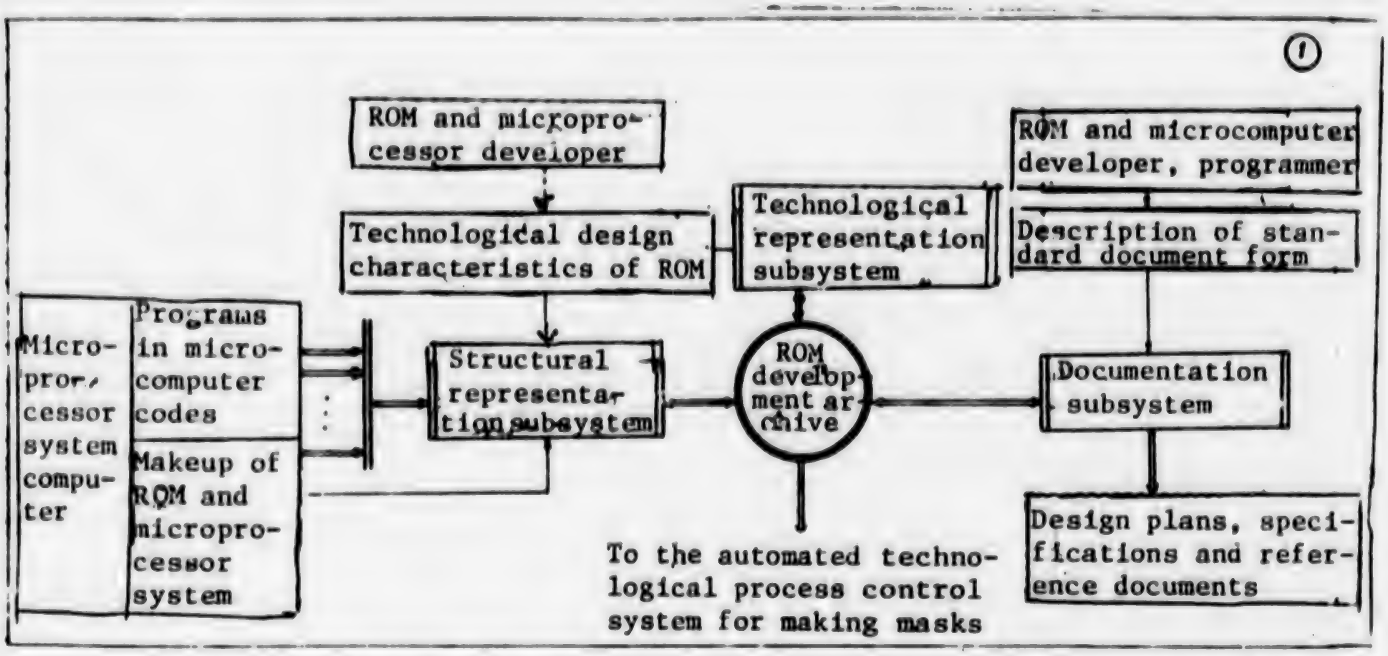
The application of this system in the software of the integrated design complex is described in [2].

System Architecture

Figure 1 shows the architecture of a system that integrates the development and production of applied program ROM for microcomputers. The basis for the architectural solution is the idea of combining the subsystems for gathering, conversion and transmission of information around a central archive. Each of the subsystems is capable of operating in the autonomous mode. Information exchange is realized between them through a united archive in accordance with the archive interaction rules.

The software works with two types of information in the system: subject, directly relating one production cycle or another (control of the phototypesetting equipment, filling out design plans and specifications, and so on) and reference information designed for making decisions during development and production.

All of the information in the archive is organized in the form of named files which can be divided into the design files and the system files. The design files contain both subject information and reference information pertaining only to the design of a specific microprocessor system. The system files are the files of topological design parameters, the ROM components of microcircuits and also various tables of relations. The files are placed on several levels of the archive distinguished by restrictions on access to the information.

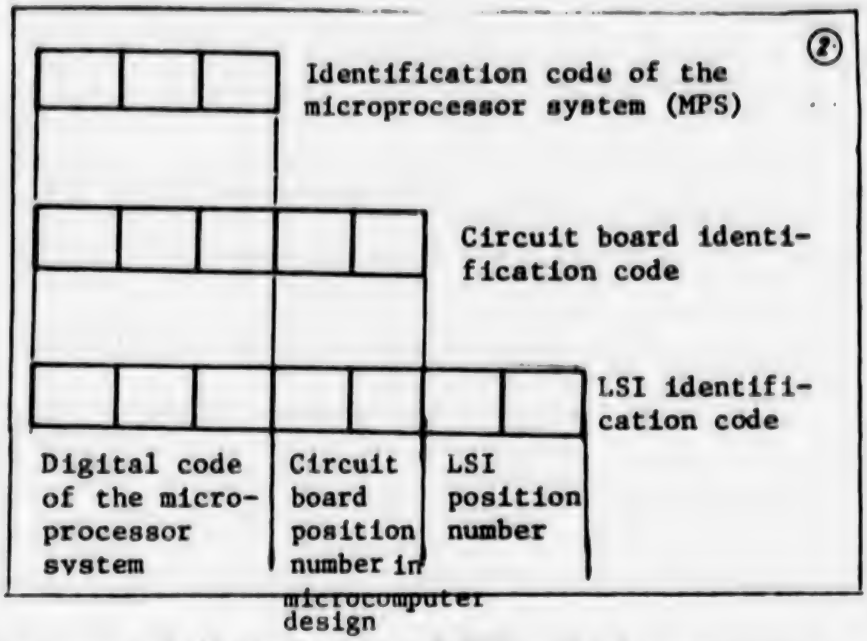


Architecture of means of integrating the development and production of programmed ROM for the Elektronika S5 microcomputers.

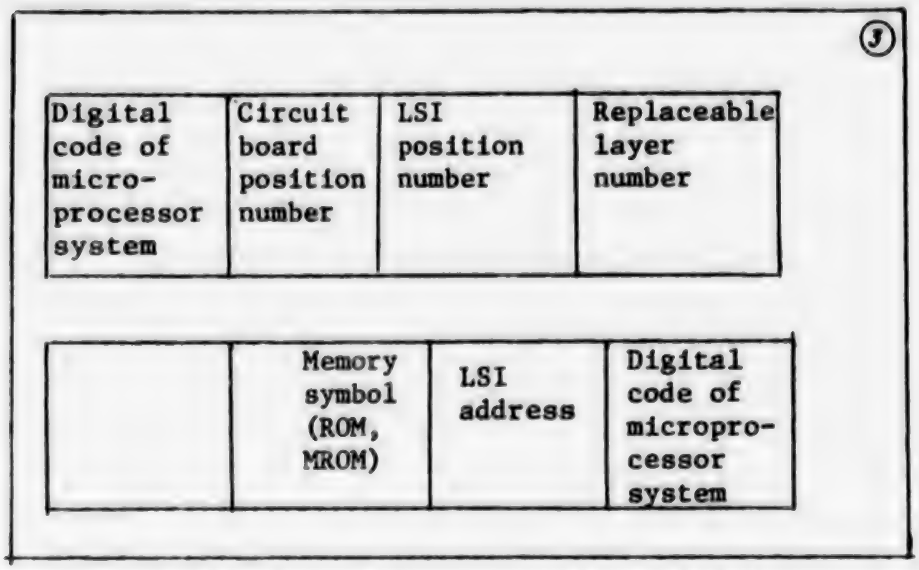
For manipulation of archive information, a system of names has been adopted. The names are divided into two groups: external and internal. The external names identify the microprocessor system, the ROM circuit board, the LSI of the ROM at the input to the system, where the name of the microprocessor system figures in two forms in contrast to the names of the ROM circuit boards and the LSI of the ROM. This is explained by the fact that the name of the microprocessor system is the identifier of the relation of the program information to the ROM configuration in the specific microcomputer. Therefore it must be represented both on the level of abstract programs (the level of the microprocessor system customer) and on the level of the technological design plans and specifications (the level of the microcomputer manufacturer). Hence there are two forms of representation most convenient in each case.

For the microprocessor system customer, the name of this system is a set of six symbols. This name is checked by the system only on comparison with the names of other microprocessor systems. If the names do not compare, the microprocessor system is assigned a systems digital code which is also a second form of representation of the name. The names of the ROM circuit board and the LSI of the ROM are formed by assigning the position number of the circuit board in the microcomputer design for the circuit board and the position number of the circuit board and position number of the LSI on the circuit board for the LSI of the ROM to the digital code of the microprocessor system (see Figure 2).

The structure of the digital names permits their use as identification codes for the corresponding products determining that the ROM circuit board or LSI of the ROM belongs to a specific microprocessor system with accuracy to the position in the microcomputer design. This identification code appears to be convenient for designating the information characteristic of the ROM components both during manufacture and during document circulation.



Structure of digital names of ROM and microprocessor system components (each position is a decimal number)



Structure of internal names: topological information file for controlling the phototypesetting equipment (a); basic program information file (b).

The internal names are designed to designate archive files and are not accessible to the user. The basis for the structure of the internal name is the structural mapping of the abstract memory zone on the structural design of the microcomputer. The names shown in figure 3 can serve as an example.

The adopted system of names is recognized to protect archive information from random access both on the system level (as a result of automatic regeneration of

the names, the base for which is the name of the microprocessor system) and on the level of the user by introducing passwords for each microprocessor system in some cases regulating access to the information (administrative restrictions).

The fixing of the structure of the archive files and system of names serves as the basis for constructing the interface for archive interaction on connection of one automated data processing system or another to the archive. One of the examples of such a subsystem can be the operative reporting subsystem on the course of filling a request and developing the ROM and the state of the archives in the design phase.

Source Information. Classification of Users

All users of the system are divided into two groups: the ROM customers, the developers of the ROM elements and microcomputer models.

Among the ROM customers, the basic customers are those for the microprocessor systems, that is, the developers of the target problem programs (there is also input for customers of nonsystem LSI of ROM, but it is not characteristic for the investigated integration system) which goes through checkout using the programming automation systems (SAP) delivered on various types of computers. A result of the work on the SAP is program information in microcomputer codes designed for entering in the memory zone of the LSI of the ROM. With respect to form of representation, this information abounds in a variety of formats and physical carriers (magnetic tape, magnetic disc, punchcards, punchtapes, text listings, and so on) which explains the large number of inputs for program information shown in Figure 1. In addition to the applied programs, the customer for the ROM of microprocessor systems is obligated to communicate data on the memory configuration to the system. This is connected with the fact that some models of microcomputers have a common on-line memory and ROM zone, and choice of the relation between them is up to the customer to make.

The developers of the ROM elements and microprocessor models access the system significantly more rarely than the ROM customers. The purpose of their accesses is to adjust the system to a modified element base of the ROM, input of the parameters of the basic structural elements used when operating all three subsystems indicated in Figure 1.

System Functions. Implementation

The functions of the investigated system are divided into automatic and nonautomatic. The latter encompass the problems of servicing the ROM customers in the various phases of filling out the order and performing the development and documentation of the ROM. The automatic functions are software-hardware functions and are connected with solving the following problems:

input and storage of the routine configuration of the ROM of the microprocessor system;

input, conversion and storage of the initial source information for filling the ROM zone;

organization and management of the archive;

generation of an interchangeable set of design plans and specifications;

generation of reporting and reference (operating) documents on the execution of individual phases of operation;

design of an intermediate mask for the replaceable layer of the LSI of the ROM and preparation of control information for the phototypesetting equipment;

control of the process of step-by-step designing when using software-hardware means;

support of the inquiry-response mode for obtaining operating reports and design plans and specifications.

The ideology of the structure of the system provides for operation of it in the form of a series of operations extended in time with respect to execution of automatic and nonautomatic functions.

The operating rules with respect to executing automatic functions are regulated by the rules for the procedure for making a request and the enterprise standard encompassing the structural principles and procedure for handling the design plans and specifications.

The universal BESM-6 computer is used to execute the automatic functions. This computer has the minimum possible reserves for organization and keeping of the archive and displaying graphical information.

The means of executing automatic functions include software written in FORTRAN. The organization of the archive of ROM developments is based on previously developed software of the information support subsystem permitting transition from the logical level of file organizaiton to the physical level of placing the information on magnetic tapes and magnetic discs [3].

The communication between users and the system for executing automatic functions is in the assigment control language which is determined by the set of directives (control inputs with respect to driving the automatic functions) formulated as access to a subroutine. Any access to the system is made within the framework of the operating system DUBNA and must be represented at its input by the user problem.

Conclusion

The construction of an automated system integrating the development and production of applied programs for the Elektronika S5 microcomputer executed on the universal BESM-6 computer provides for creation of a united information base for different subdivisions of the manufacturing enterprise engaged in development, production and checking the LSI of the ROM and the ROM circuit boards of microcomputers.

The modular principle of constructing the system using a central archive offers the possibility of expansion when developing new models of microcomputers and ROM elements and information conversion and transmission subsystems. The execution of the operations of preparing the control information for the process production and control equipment in one cycle and documentation of the developed ROM and microcomputers on the level of preparing an information description create the prerequisites for decreasing production losses and reducing the total times required for

development and production of ordered ROM and microprocessor systems as a whole.

It must also be noted that proper organization of the operation of the system taking into account not only the functional purpose but also orientation to the series production conditions has enormous significance for efficient operation of this system. Only in this case will introduction of an automated system permit the time to be reduced and insurance of defect-free ROM developments as a result of reducing the participation of man in the information transmission, conversion and storage process to a minimum.

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10845
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UDC 681.325.5-181.4

CHECK SYSTEM OF MICROCOMPUTER BUILT ON BASIS OF K580IK80 LSI

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
(manuscript received 15 Sep 80, after revision 24 Feb 81)
pp 62-67

[Article by Valeriy Aleksandrovich Krasavtsev, engineer, and Aleksandr Davidovich Kaluzhskiy, candidate of technical sciences, Leningrad Production Association imeni Kozitskiy]

[Text] Introduction

One of the problems that comes up when creating onboard control systems is insurance of high operating reliability of them.

Rigid requirements on the size and weight characteristics of such systems and complexity of the algorithms implemented by them justify the effort to make broad use of microprocessors in such developments. At the same time, the series-produced microprocessor sets do not contain any check hardware without which sufficient reliability of onboard control systems cannot be insured.

Individual publications on the problems of checking microprocessor systems [1-4] are of the nature of information reports or consider special problems of organizing checking (checking individual modules, methods of software-hardware implementation, and so on). This complicates comparative analysis of the known check methods (autodiagnostics, signature analysis, methods of using equipment redundancy and majorizing), determination of prospective areas in the construction of check systems and selection of optimal methods of checking microcomputers considering rigid size and weight requirements and other restrictions.

In this article one of the possible versions of the microcomputer check system executed on the basis of the K580IK80 microprocessor is discussed.

It is proposed that checking of a microcomputer be implemented using built-in software-hardware, so-called automatic diagnostic means. By comparison with other check methods which make use of equipment redundancy, majorizing, signature analysis, built-in check and diagnostic means are the most acceptable for the given microcomputers considering the element base used, the size and weight characteristics, requirements with respect to repair and maintenance and also a number of restrictions (intake power, absence of hot stand-by) and, in our opinion, they insure sufficient efficiency of the check means with minimum additional equipment expenditures.

The basic equipment expenditures when using automatic diagnostic means are on additional memory with an insignificant increase in other hardware. It is necessary to note that by comparison with other microcomputer check techniques, this method does not increase tne ratio of the size of the additional memory used for checking to the total volume of usable memory for solving basic problems. This is connected with the fact that in the absence of hot stand-by and organization of checking microcomputers by the majorital principle or with the use of equipment redundancy[1], it is also necessary to solve the problems of checking the fitness of the microcomputer, diagnosing failures, repair and control of the microcomputer means, and, consequently, approximately the same amounts of additional memory are required.

Checking of microcomputers is organized on the basis of periodic checking of fitness of the microcomputer used (where this is possible) in combination with continuous checking. With this approach after defined time intervals (check periods) and also always when pauses in the operation occur when the microcomputer is not busy solving basic problems, an estimate is made of the state of the basic equipment of the microcomputer, by the results of which a decision regarding the state of repair of the microcomputer is made with defined reliability of the check system. The duration of the check period is determined by the nature of the solved problems, and it is given when designing the software.

On the whole, the check system permits the following to be performed:

check the fitness of the microcomputer, protection and diagnosis of system errors (failures) occurring during the operating process;

check the random errors;

repair and preventive work under operating conditions.

Checking of the microcomputers is implemented as a set of built-in software-hardware and includes programs for test and functional checking of microcomputers, failure diagnostic programs, a number of additional programs for special and systems software organizing and checking the information processing and also additional checking equipment.

Microcomputer Check System Software

The test and functional methods of checking are a system of tests and functional checking problems which check the fitness of the microcomputers with respect to generalized quality indices when starting up the system or performing adjustment operations and also periodically under operating conditions on occurrence of pauses in the operating process (when the microcomputer is free of the solution of "useful" problems). Here, in the first case a more complete check is made on the microcomputer, during which its communications with coupled hardware are completely blocked. In the second case the check is done in smaller volume, but the operation of the microcomputer as part of the system is not disturbed.

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[1] By equipment redundancy we mean use of two identical logical circuits operating in parallel for checking.

In addition, test programs are used when diagnosing failures and also when performing preventive work.

Test Checking of Microcomputers. Depending on the purpose, tests are divided into preventive and operating tests. During checkout a study is made of the possibility of selective testing of individual modules of the microcomputers, the composition of which is given by an operator from a connected engineering panel.

The preventive test is designed for complete testing of all devices during initial startup or starting after repair of the microcomputer. The test is switched on by the operator from the panel by pressing the PUSK [START] button (it takes about 3 seconds to perform the test). Inasmuch as after repair of a microcomputer the working zone of the on-line memory can contain information necessary for continuation of its operation, the preventive test includes only a partial test of the on-line memory checking a specially defined zone of memory cells. The complete on-line memory test can be included in the preventive test only on instruction from the operator (by pressing TEST button before starting the microcomputer).

The operating test is designed for periodic checking of the basic equipment of the microcomputer during its operation. The test is initiated by the systems programs of the microcomputers organizing its operation. When necessary, the working test can be interrupted for the time of solution of the basic problems. On completion of solution, the execution of the test continues from the point in the program at which the interrupt took place.

Each of the indicated tests is a set of tests of individual modules making up the microcomputer which do successive testing beginning with the basic assemblies (the core of the microcomputer) and ending with the peripheral devices. Here each elementary test checks for correctness of satisfaction of defined check relations. Each subsequent test checks a larger volume of microcomputer equipment by comparison with the preceding one and is constructed on the basis of the check relations already checked out.

By the checkout results using one test or another, either a transfer is made to the next test in order or the given test is repeated to establish the fact of failure or error on the part of the microcomputer. Repeated failure of the test is taken as a computer failure.

Functional Checking of Microcomputers. Along with test checking, functional checking is also used. It is designed for checking the correctness of the interaction of the hardware and software of the microcomputers used in the solution process, that is, checking out the microcomputer as a system oriented to solving a defined class of problems.

Functional checking is carried out on the basis of performing a number of control problems. In contrast to the tests, the checkout is made not for individual check relations, but the entire solution process with final results and initial data given in advance. It is expedient to include the functional checking means in the microcomputer checking means and to consider it when designing the software also from the point of view of organizing the checking system including the microcomputer. The volume and organization of functional checking of a microcomputer are closely related to checking the entire control system and are determined after solving its checking problems.

Random Error Checking. Random errors occur during operation of the microcomputer in the working mode, and they are monitored basically by software techniques using the following:

the principle of double calculation of the problems;

the principle of tracing the execution of the problem algorithm with respect to check points;

checking the execution of programs by time (with respect to the number of computer cycles in the program).

When solving individual problems, depending on the equipment used (when it is impossible to use the above indicated checking methods) some special monitoring procedures are used. These include semantic and syntactic checking of the results of the solving the problems and the input messages, checking the correctness of interaction with peripheral equipment, feedback program checking (acknowledgement) during data exchange, and so on.

When detecting errors in the course of the solution, just as in the case of test checking, the microcomputer control is transferred to the system error analysis programs (PAS) and failure analysis program (PAN). By the results of the analysis, depending on the nature of the error, either failure of the microcomputer is determined and the processor is shut down or the decision is made to continue operation. Possible versions of further operation of the microcomputer are considered in more detail below. Here we shall note the following.

Absence in the microcomputer of means of through hardware checking leads to the fact that it is not always possible to identify an error at the time of its occurrence. Accordingly, on establishing the fact of an error it is not always possible to continue further operation of the microcomputer, for the consequences of the error can be impossible to eliminate by the microcomputer means themselves, and for continuation of normal operation in this case it is necessary to set up a special recovery mode by system means or by the operator (in particular, recovery of information stored in the on-line memory of the microcomputer).

An approximate estimate of the required memory sizes used for monitoring purposes and also time characteristics of the software are presented below.

Microcomputer Check Hardware

This hardware has been developed to supplement the software and makes it possible to increase the software efficiency with comparatively low expenditures.

The hardware provides continuous checking of a number of modules, the hardware execution of certain check functions and interaction of the check system with the operation control means of the microcomputers and display of the check results.

The check hardware of a microcomputer includes the following. A programmable monitoring timer (clock) is used for recycling checks and checks from transfers not provided for by the program in case of errors in execution of the working programs;

when the time relations given for each program are not satisfied, the timer generates the signal CLOCK FAILURE.

The time mark generator is used to time check the general solution process and check the operation of individual modules. Each time mark generated is received and processed by the microcomputer. If the mark is not received by the microcomputer as a result of halting of the processor or the occurrence of a failure, then with arrival of the next mark, the TIME MARK FAILURE signal is generated.

The on-line memory parity check circuit which is used to detect individual errors when writing, storing and reading information from the on-line memory is used to check for errors in the operation of the on-line memory by comparing a check bit generated when reading a byte of information with the code formed for the byte when writing the information; in case of a failure, the ON-LINE MEMORY FAILURE signal is generated.

The check system for testing a central processor module (the central processor arbitrator) is designed to increase the reliability of the central processor modulus check and compare the central processor test results with a previously defined constant for the given time interval. Depending on the results of the check either further operation of the central processor is permitted or the CENTRAL PROCESSOR FAILURE signal is generated.

The microcomputer failure register is designed to identify errors and failures. Information stored in the register is used when analyzing failures.

The hardware error counter is used to calculate the number of failures detected by the check hardware. If the error counter overflows, the signal for hardware switching to reserve (in the presence of a reserve on-line memory) is generated or the MICROCOMPUTER FAILURE signal is generated.

The display units are designed to display information characterizing the condition of the microcomputer under different operating conditions. In accordance with the nature of the displayed information, the generalized signal field for the condition of the microcomputer (OPERATING, IN GOOD REPAIR, ATTENTION, MICROCOMPUTER FAILURE, SYSTEM FAILED) and the failure field of the microcomputer and individual modules are distinguished.

Microcomputer Control Elements

The RROZU1 and RROZU2 (OZU [on-line memory] operating mode) switches are designed to assign the initial operating configuration of the on-line memory modules reserved in the microcomputer. They are established by the operator before the initial startup or startup after repair of the microcomputer. The operating mode is set for the on-line memory module in which operative information is required for continuation of the operation of the microcomputer as part of the system is preserved.

The PEREPIS' [COPY] switch allows the information to be copied from the working module of the on-line memory into reserve and forbids an on-line memory test. Combined with the RROZU switches, the TEST switch excludes the unplanned loss of information stored in the on-line memory.

The TEST button permits testing of memory as part of the preventive test on the microcomputer.

The AUTONOMOUS OPERATION/SYSTEM switch assigns the operating mode of the microcomputer as part of the system. In this mode the couplings of the microcomputer to the system are blocked. This operating mode is used to check out the microcomputer.

Operation of Microcomputers in the Startup Mode

When power is switched on, general initialization of the microcomputer takes place, the CHECK mode is setup in the hardware, and the communications between the microcomputer and the system are blocked.

After the required initializations (setting of the AUTONOMOUS OPERATION/SYSTEM, TEST, COPY, RROZU switches) the operator starts the microcomputer and switches on the preventive starting mode test of the microcomputer.

It must be noted that inasmuch as program methods make up the basis for the check, before beginning to test the modules and also on each access to the PAS and PAN on detection of failures, the so-called DOVERIYE [CONFIDENCE] program is run which checks the performance of the basic processor operations, on the basis of which a further analysis of the failures and checking the execution of the individual tests are set up.

On failure of the CONFIDENCE program to run, the failure signal fixed by the hardware error counter is formed by the hardware, and the microcomputer is restarted. If the CONFIDENCE program fails to run again, the error counter will overflow, and the MICROCOMPUTER FAILURE and CENTRAL PROCESSOR FAILURE signals are formed and initiated.

After execution of the CONFIDENCE program, a test is run on the microcomputer modules to the extent determined by the preventive test. On failure of any test, as has already been pointed out above, the same test is tried again. In case of systematic error the PAN forms signals of failure of the corresponding model and failure of the microcomputer.

If the module failure does not lead to failure of the microcomputer (that is, the microcomputer can continue to function with worse parameters), then instead of the failure signal, the ATTENTION signal (for example, for switching to the reserve online memory) is generated simultaneously with the signal about a module failure.

With positive test results, a functional check is run on the microcomputer, after which the IN GOOD REPAIR signal is sent, and the microcomputer is switched from the check mode to the operating mode with display of the corresponding signals. The system inputs and outputs of the microcomputer are unblocked simultaneously.

If during the functional check it is discovered that the microcomputer is unable to perform its basic functions and the diagnostic and test check medium have not detected failures of the basic equipment, then the check system forms and initiates the SYSTEM FAILED signal. This signal can be formed also during the process of solving problems on occurrence of failures caused by incorrect interaction of the microcomputer equipment and absence of communications with the system.

Microcomputer Check in the Operating Mode

After switching the microcomputer to the operating mode in the presence of requests to solve problems, control is transferred to the operating programs.

On detecting an error during the solution process, an analysis of the causes of the failures is run. Depending on the results of the analysis (random or systematic error) and the nature of the solved problems, the following cases of further operation of the microcomputer are possible:

repetition of the solution of the problem during which the error was detected;

shaping of the signal that the corresponding module has failed and switching to reserve on detection of a systematic error. The solution process is repeated with a new configuration of the microcomputer modules; if switching to reserve does not eliminate the systematic error, the microcomputer FAILURE signal is formed;

the problem is taken out of the solution process with the corresponding message being sent to the system, and the microcomputer goes on to the solution of the next problem;

after elimination of the consequences of an error, the execution of the interrupted operation continues;

for certain errors, just as in the case of detecting systematic errors, microcomputer FAILURE or SYSTEM FAILED signals are formed, and the microcomputer is halted. Further operation of the microcomputer in this case is possible only after complete repair of it (including recovery of the operative information in the on-line memory zone) by system means or with the help of the operator.

In the case of the occurrence of failures during information exchange between the microcomputer and the system over the communications channels, analysis of the causes, inclusion of the diagnostic tests, and channel equipment control are carried out by a program directly servicing the given unit and not under the control of the microcomputer systems programs. The systems programs receive only the final results of the analysis, on the basis of which working with the given channel is organized thereafter (for example, REPEAT MESSAGE, TAKE THE GIVEN MODULE OUT OF THE OPERATING CONFIGURATION, and so on).

In the absence of requests to execute working programs, the working microcomputer test is started, on execution of which the same check methods are used as when performing the preventive check.

Approximate characteristics of the software-hardware means of checking out microcomputers are presented in Table 1 and Table 2.

Conclusion

The described software-hardware check means permit detection of systematic errors, checking the operating fitness of the microcomputer and detection of random errors with defined reliability.

Table 1. Software-hardware check of microcomputer modules

Name of modules	Check software			Check hardware
	Name	Quantitative characteristics		
		Volume	Execution time	
ROM, programmed ROM	Check sum test:			
	partial	≈150 bytes	≈15 msec	--
	complete	≈150 bytes	≈1.6 sec	
On-line memory	Short test	≈300 bytes	≈300 msec	Continuous parity check
	Long test		2 to 3 min	
Central processor module	Central processor test	≈1K bytes	≈10 msec	Periodic check using central processor ARBITRATOR system Continuous halt check of central processor
Priority interrupt module (BPP)	BPP test	≈100 bytes	≈2 msec	Continuous time mark check
Timer module	Programmed timer test	≈200 bytes	2 to 3 msec	The same
	Interval timer test	≈50 bytes	0.6 to 1 sec	
Module for coupling to the manual instruction input block (BRVK)	BRVK test	≈300 bytes	≈50 msec	Special solution
	Programmed information exchange check	Part of the service program		
Module for coupling communications equipment channel to system (PRMDS)	PRMDS test	≈300 bytes	≈30 msec	Special solution
	Programmed information exchange check	Part of the service program		Continuous ex-check with respect to time
	Semantic and syntactic check of received information	Part of the EDITOR program		
Module for coupling to the teletype	RTA [radiotelegraph equipment] test	--	--	--
		--	--	Continuous feed voltage check
Power supplies	--			

The built-in diagnostic means of microcomputers permit determination of the location of the occurrence of failures with accuracy to a module and at the same time they simplify performance of repair and recovery operations by the service personnel.

Estimating the expenditures required to implement the check system indicates that the additional equipment (including the additional memory) will amount to approximately 20 to 25% of the total equipment with an overall increase in labor expenditures for software development in connection with complication of the operation of the microcomputer.

Table 2. Software-hardware means of checking out, diagnosing and repairing microcomputers

Type of check	Check software: Name	Check software: Quantitative characteristics: Volume	Check software: Quantitative characteristics: Execution time	Check hardware
Microcomputer check:				
a) operation check(test and functional)	Preventive tests	2.5K bytes	3 sec (with on-line memory test, 3 min)	On-line memory parity check Program execution time check Central processor test check
	Operating test	1.5K bytes	10 msec	Time mark check
	Functional test	1K byte		On-line memory parity check
b) random error check during solution	Repeated calculation of the problem	10-20% of required memory for solved problem	--	Program check with respect to execu-time
	Program tracing of execution of problem algorithm			Time mark check
	Solution check with respect to time			
	Special program methods			
Failure diagnosis	Error and failure analysis programs	0.3K byte	--	Failure register
	Diagnostic tests			Hardware error counter
	CONFIDENCE program			Display systems
Automatic recovery of operating fitness of microcomputer	Program for eliminating consequences of errors	10% of problem memory	--	Reserve control system
	Reserve control program	0.5K bytes		
	On-line memory recovery program			
	On-line memory copy			

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DEVICE FOR DISPLAYING SYMBOLIC INFORMATION ON PLASMA PANEL

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81 (manuscript received 4 Oct 79) pp 129-130

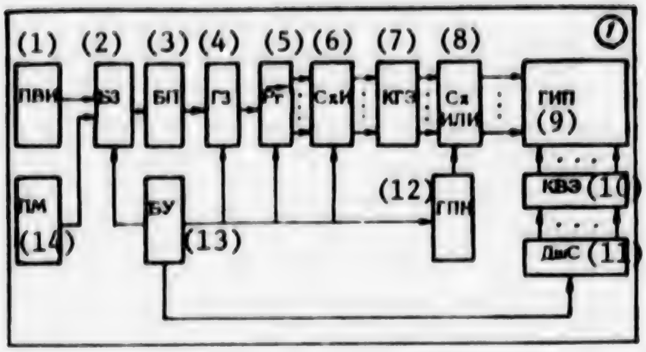
[Article by Sergey Ivanovich Lavrent'yev, Vladimir Aleksandrovich Minenkov, Aleksandr Alekseyevich Sviyazov, engineers, and Aleksandr Maksimovich Smolyarov, candidate of technical sciences, Ryazan' Radiotechnical Institute]

[Text] In the monitoring and control systems and in experimental research, great volumes of information coming from the investigated object are usually processed on a computer and are output to the data displays (UOI). In research practice, cathode-ray tube displays are widely used as UOI [1]. However, along with advantages, such devices are also characterized by disadvantages [1, 2]. Accordingly, work is being done to build UOI based on flat matrix panels. Among the prospective ones are the gas discharge matrix panel UOI [2-4].

A study is made below of the results of developing a symbolic information display based on a gas discharge alternating current display panel (plasma panel). Figure 1 shows the functional diagram of a device containing a gas discharge alternating current display panel GIP, high voltage vertical electrode switches KVE, decoder DshS, OR diode circuits Skh ILI, high voltage horizontal electrode switches KGE, coincidence circuits SkhI, shift register Rg, sign generator GZ, memory BP, control unit BU, maintenance voltage generator GPN, recording unit BZ, data input panel PVI, and typewriter PM.

The column-by-column control mode is used in the device. Bipolar maintenance voltage pulses are fed to the horizontal electrodes of the panel. At the time of feeding the maintenance pulses, the vertical e ectrodes are connected through the open high-voltage switches KVE to a common wire. When feeding a negative write pulse to the horizontal electrodes, apositive halfaccess pulse is fed to the vertical electrodes.

The device operates as follows: the symbol location address code is fed from the control module through the write module to the memory module. The code for the symbol entered in this address appears at the output of the memory module and is converted in the symbol generator to the first fragment code in accordance with the control module signal and the outline of the symbol. By a fragment we mean a column of the symbol location cells.



Key:
1. PVI
2. BZ
3. BP
4. GZ
5. Rg
6. SkhI
7. KGE
8. OR circuit
9. GIP
10. KVE
11. DshS
12. GPN
13. BU
14. PM

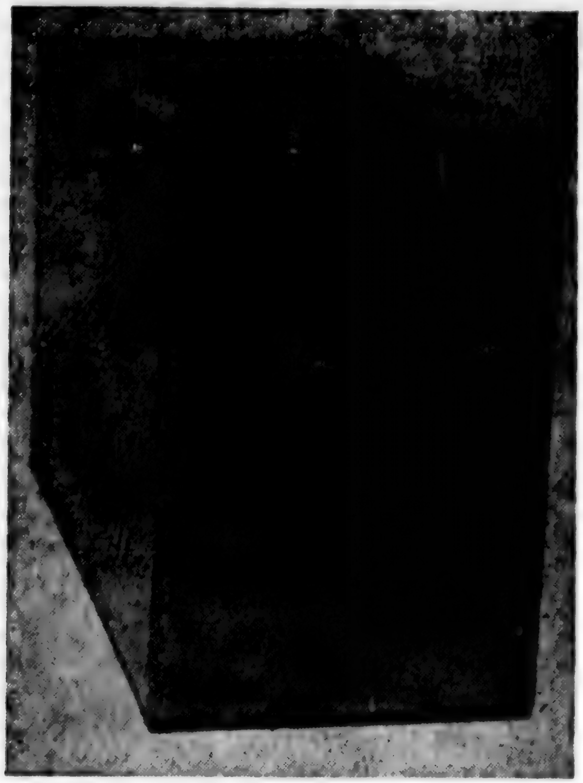


Figure 2

On arrival of a pulse from the control module, the fragment code is entered in the shift register, and the address code of the next symbol location goes to the address inputs of the memory module. The symbol code is converted analogously by the symbol generator, and the fragment code is entered in the shift register. The codes previously entered in the register are shifted "up." This conversion and writing in the shift register take place with high speed until the codes of all of the first fragments of the symbol location columns are entered. Then output of the address codes to the memory module and writing in the shift register cease, and write control pulses come to the coincidence circuits SkhI from the control module.

The coincidence circuits control the high-voltage switches KGE. The write pulse of negative polarity goes through the OR diode circuits to the horizontal electrodes of the panel. Positive write halfaccess pulses go to the vertical electrode corresponding to the codes for the fragments entered into the register. The voltage applied to the corresponding cells of this column is greater than the ignition voltage; therefore the cells light. As a result, the first fragments of the selected column are displayed on the panel. In order to increase the reliability of ignition of the cells, nine write pulses are sent. The glow of the lit cells is maintained by the bipolar pulses from the maintenance voltage generator which go to the horizontal electrodes through the OR diode circuits.

After entering the first fragments of the selected symbol location column on the panel, the codes of the first fragments of the next symbol location column are entered in the shift register. Ignition of the cells located on the vertical electrode corresponding to the first fragments of the second symbol locations is realized analogously. Thus, cells reproducing the first fragments of all symbol locations light up successively on the panel. Then the cells depicting the second fragments in all the columns of symbol locations light successively, and so on. As a result, all of the selected cells light and the entire information frame is displayed. After ignition, the glow is sustained by pulses from the maintenance voltage generator. The information can be written into the display from the "Konsul-260" typewriter, from the information input panel or from a computer. When entering from an information input panel or computer, the symbol code and address code are sent to the display.

Information can be entered on the panel successively or selectively on any symbol location of the panel. The information can be entered successively from a typewriter beginning with the upper left-hand corner of the panel. During successive entry the address codes are generated by the write module. For erasing the information, blank codes are entered in the memory module. The information is erased from the panel by lowering the maintenance voltage amplitude.

In order to increase the reliability of ignition of the cells of the gas discharge matrix panels usually a stepped-up feed voltage is supplied (creation of an overvoltage), a glow strip is used [4], reversible scanning [5], and so on. In the developed device, a glow strip is used for this purpose. In order to prepare the device for operation, it is switched for 10 or 12 seconds to warm up. A stepped-up voltage is fed to the glow strip electrodes, and all of the cells burn on the panel, after which the strip voltage is reduced to the rated voltage and all the remaining cells are extinguished.

The device is executed from series 133 microcircuits. The 505 RYe 3 0063 microcircuit is used as the symbol generator. High voltage switches are assembled from the P308 and and 2T203 transistors. The transistors GT806 and 2T809 are used in the maintenance voltage generator. The memory module is executed from the K 527 RU2 microcircuits, and it has a capacity of 512 nine-bit words.

The external appearance of the developed information display is illustrated in Figure 2.

The device can find application in automated control systems, automated technological process control systems, data gathering, processing and display systems, in central monitoring systems, and so on.

At the present time preparations are proceeding for small-series production of the device.

Technical specifications of the device

Cell screen capacity	128 × 128
Spacing between cells	0.8 mm
Number of symbol locations	216
Number of symbols in a row	18
Read range	1.5 meters
Page number	2
Brightness of the glow element	100 candles/m^2
Symbol format	5 × 7
Intake power	100 watts
Overall dimensions	200 × 270 × 500 mm
Weight	6 kg

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COMPUTER NETWORKING DEVELOPMENT IN LATVIA

Riga SOVETSKAYA LATVIYA in Russian 29 Nov 81 p 4

[unsigned article]

[Text] The Institute of Electronics and Computer Technology of the Latvian SSR Academy of Sciences is a major scientific center in the Republic. Work is underway here on solving problems involved in creating computer networks -- problems for which the importance of achieving a solution on a nationwide scale was defined by the 26th CPSU Congress. The logical culmination of the major scientific work in which the collective of the institute is participating is to be a unified national network of computer centers in this country.

Scientists at the Institute of Electronics and Computer Technology of the Republic Academy of Sciences have been experimenting for several years on the interaction of computers located in different cities, using telephone lines. It is perfectly normal for computers in Riga and Moscow to work together.

In the photograph: packet-switching center in experimental computer network of Latvian SSR Academy of Sciences. (Left to right) laboratory supervisors Mikhail Kaltygin and Valeriy Ivanov-Loshkanov.

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HARDWARE COMPLEX OF COLLECTIVE-USE COMPUTING CENTERS

Moscow VESTNIK STATISTIKI in Russian No 11, Nov 81 pp 43-51

[Article by Yu. Letskiy, A. Shchukin and V. Yashin]

[Text] The hardware complex (KTS) of collective-use computing centers (VTsKP's) should make it possible for numerous users to utilize more fully the resources of VTsKP's. The architecture of hardware has been developing strongly with the introduction of information teleprocessing equipment and the creation of automated data banks (ABD's). It has been proposed that at VTsKP's there will be extensive use of data teleprocessing methods, of the dialogue mode of users working with ABD's, of the debugging of programs in the time-sharing mode, and of the processing of information under conditions of a distributed data bank.

The basis of a VTsKP is a multimachine complex consisting of several computers with a joint external and on-line memory field. One computer performs the functions of the central controller and various problems of users are solved by means of the remaining. Experience gained from four collective-use computing centers created within the USSR TsSU [Central Statistical Administration] system in the 10th Five-Year Plan period has demonstrated that 2-, 3- or 4-computer complexes are advisable, specializing in solving problems by the teleprocessing method and in conducting an automated data bank and the package processing of data. The computers must have an on-line memory with a capacity of not less than 1 Mbit, must be interlinked by means of adapters through selector communication channels and must operate under the control of a distributed operating system. As the basic machines at a VTsKP it is possible to use computers of the YeS-1045 and YeS-1065 types and as central controllers--a computer of a class not below a YeS-1033.

The basic problem in selecting hardware is determination of the type and number of computers, as well as of an efficient user's network with a set of user stations (AP's). The procedure suggested for selecting hardware is based on the use of analytical models reflecting the most common patterns of data processing at a VTsKP, and taking into account both the regular and random nature of the stream of requests for service when users turn to the center's computing and software resources. The procedure contains basic recommendations relating to the selection of the computing complex of a VTsKP and of user stations for users, developed on the basis of know-how gained in creation of the VTsKP in the USSR TsSU system.

Collective-Use Computing Center Computer Complex

The configuration of a 3- and 4-machine computer compl is shown in fig 1. The central controller computer accomplishes the exchange of information through communication channels and controls the operation of the entire hardware complex, and the remaining computers are the primary computers (work under the control of the central controller).

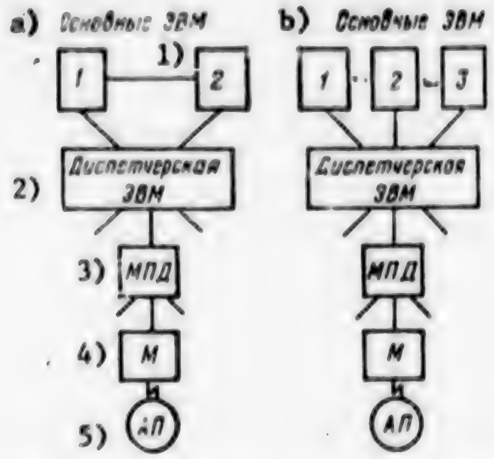

Figure 1. Configuration of 3-Machine (a) and 4-Machine (b) Computer Complexes

Key:

1. Primary computers
2. Central controller computer
3. Data transmission multiplexer (MPD)
4. Modem (M)
5. User station (AP)

The selection of the types and number of computers is a basic question in specifying a computer complex. The following relationship can serve as a condition for selection of the computer complex: $\Sigma V_{EVM} \geq V_{tr}$ ($V_{EVM} \cdot n \geq V_{tr}$ for computers of the same type), according to which the total performance of all computers of the complex must surpass the performance required for solving the VTsKP's problems; V_{EVM} is the performance of a single computer in operations per second; n is the number of computers in the complex; and V_{tr} is the performance required for solving the VTsKP's problems (in operations per second).

The required performance necessary for solving routine problems and for computing and data processing tasks with the random arrival of requests is determined from the equation:

$$V_{тр} = \frac{(P_р + P_с) K_{сп}}{3600 \cdot T_с \cdot K_и \cdot K_г \, K_н},$$

where R_r is the volume of computing work for solving routine problems in 24-h periods with the maximum load, in operations; R_s is the amount of work with the

random arrival of requests in 24-h periods with the maximum load, in operations; K_{sp} is the system loss factor for the organization of data processing (processing in the time-sharing mode, multiprogram mode, etc.); T_s is the scheduled 24-h operating time of the computer in hours; K_g is the computer availability factor; K_n is the factor for non-productive expenditure of time for the computer's operation (performance of preventive work, idle time, etc.); K_m is the performance improvement factor when solving problems in the multiprogram mode. R_r, taking into account expenditures for organizing exchange with communication channels, equals:

$$P_p = \sum_{i=1}^{n} Q_i \gamma_i + Q_{ks} \gamma_{ks},$$

where Q_i is the amount of input information to be processed for the i-th group of tasks in 24-h periods with the maximum load, in alphanumeric characters; γ_i is the mean number of machine operations necessary for processing a single character of input information for the i-th group of tasks, in operations per character; Q_{ks} is the amount of information to be input and output through communication channels in 24-h periods with the maximum load, in alphanumeric characters; γ_{ks} is the mean number of machine operations necessary for organizing the input (output) of a single alphanumeric character when working with communication channels, in operations per character.

The values of the mean number of operations per single character of input information (γ_i and γ_{ks}) present a generalized characterization of the complexity of solving problems. They are determined on the basis of analyzing the solution of problems on YeS computers, taking into account organization, technological and software factors. The size of the mean number of operations includes the expenditure of operations for the input and output of information, as well as for the exchange of data with the computer's external memories.

The amount of computing work required for processing information with the random arrival of requests in 24-h periods with the maximum load equals

$$P_z = N_z \cdot \gamma_z,$$

where N_z is the mean number of requests for the performance of computing and data processing work in 24-h periods of maximum load; and γ_z is the mean number of machine operations for processing a single request, in operations per request.

The types and number of external memories in the computer's structure are selected on the basis of requirements for the distribution of amounts of information stored. External memories include tape units (NML's) and disk units (NMD's) with sufficiently great capacity and high accessing speed. The disk units used in YeS [Unified Series] computers have the following characteristics: The information capacity of YeS-5050 (Ye-5056M), YeS-5061, YeS-5066 and YeS-50 (YeS-5080) equals, respectively, 7.25 Mbytes, 29 Mbytes, 100 Mbytes and 200 Mbytes with a mean access time of 30 to 90 ms. The information capacity of tape units for the YeS-5017 (YeS-5022) is 20 Mbytes, for the YeS-5025 (YeS-5002, YeS-5003) 20 to 40 Mbytes and for the YeS-5027 120 Mbytes.

The number of external memories of the i-th type in the structure of a computer is determined from the equation:

$$N_{xi} = \frac{Q_{xi}}{Q_{vi} \cdot \eta_i},$$

where Q_{xi} is the amount of information to be stored in external memories of the i-th type in the computer's structure, in alphanumeric characters; Q_{vi} is the nominal capacity of a single external memory of the i-th type in bytes; and η_i is the utilization factor for the capacity of an external memory of the i-th type (by analogy it is possible to determine the number of disk packs and tape reels for the storage of information in the magnetic medium file).

The preparation of information for input into the computer is performed simultaneously at the VTsKP and at user stations. At the VTsKP information is entered on media by means of data preparation units, chiefly on magnetic media (about 90 percent), and on punched cards (10 percent of the entire amount of information to be prepared). The number of data preparation units for the entry onto media of information arriving in documents is determined for 24-h periods of maximum load by the equation:

$$N_{pi} = \frac{Q_{pi} \cdot K_p}{H_{vi} \cdot T_p},$$

where Q_{pi} is the amount of information to be transferred from documents to a medium of the i-th type, in alphanumeric characters; K_p is the factor for the increase in the amount of information to be prepared on account of operator errors and other reasons; N_{vi} is the output norm for an operator on a unit of the i-th type in characters per hour; and T_p is the operating time of a single unit in hours.

Single-console units of the YeS-9001 type and multi-console data preparation systems of the YeS-9003 type (up to 32 working consoles for operators) are recommended for entering data onto magnetic media.

User's Network and Collective-Use Computing Center's Teleprocessing Facilities

The objective of the remote access of users to the computing, information and software resources of the VTsKP is realized by means of user stations and communication channels making up the VTsKP's user's network, as well as by means of the computing center's complex of teleprocessing facilities. The latter include computers and data transmission multiplexers (MPD's) or data teleprocessing processors (PTD's) which make it possible to link computers with communication channels by means of modems or signal conversion units of the telegraph type (UPSTG's). When switched telephone or telegraph communication channels are used for working with a computer, the call equipment, VUTF and VUTC, respectively, is connected in parallel with the modems or UPSTG's. A routing diagram for data transmission circuits for these teleprocessing facilities when various types of user stations are connected to a VTsKP is shown in fig 2, in which TF represents telephone communication channels and TG represents telegraph.

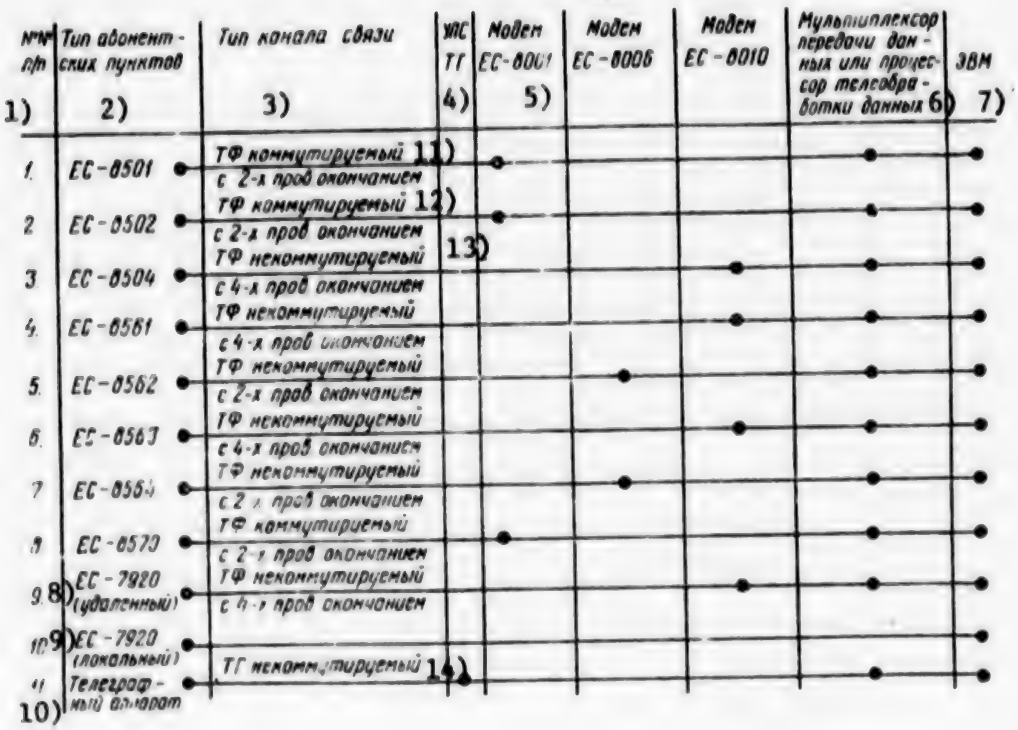

Figure 2. Diagram of Exchange of Information Between User Stations and Computer

Key:

1. Item No
2. Type of user station
3. Type of communication channel
4. UPSTG
5. YeS-8001 modem
6. Data transmission multiplexer or data teleprocessing processor
7. Computer
8. Remote
9. Local
10. Telegraph set
11. Telephone, switched
12. With 2-wire termination
13. Telephone, unswitched
14. Telegraph, unswitched

MPD's or PTD's are connected to the computer by means of 2-channel selector switches, which makes it possible, when necessary, to change the configuration of the VTsKP's data teleprocessing system. At the present time the following types of domestic multiplexers are used at VTsKP's: the MPD-1A (YeS-8400) for 16 communication channels, the MPD-2 (YeS-8402) for 176 channels and the MPD-3 (YeS-8403) for 4 channels. They operate with user stations in the user station - computer mode and make possible the exchange of information between computers in the computer-computer mode with a speed of up to 4800 bits/s. The following types of PTD's have been developed: the YeS-8371 (People's Republic of Bulgaria) and the YeS-8371-01

(Polish People's Republic), which serve up to 352 communication channels; they duplicate the work of MPD's and serve a limited list of user stations.

All MPD's and PTD's make possible semi-duplex transmission with the protection of information from errors in communication channels on the basis of matrix or cyclic codes. The probability of the appearance of an error is not greater than 10^{-6} for characters with a probability of the distortion of information in a channel of not greater than 10^{-3} for pulses.

Users are furnished with user stations (AP's) for working with a VTsKP. For YeS computers there are user stations of the AP-1 (YeS-8501), AP-2 (YeS-8502), AP-4 (YeS-8504), AP-61 (YeS-8561), AP-62 (YeS-8562), AP-63 (YeS-8563), AP-64 (YeS-8564) and AP-70 (YeS-8570) type. These AP's make possible an interactive mode of communicating with the computer. The AP-1, AP-2 and AP-4 operate also in the package teleprocessing mode with the input/output of data on media. A typewriter is used as the input/output unit in the AP-1, AP-2 and AP-70. In the AP-61 and AP-62 there is a single display and in the AP-63 and AP-64 several (not less than four). The AP-4 is a programmable terminal capable of carrying out the primary processing of data and having a varied list of peripheral devices, including tape units. SM [International System of Small Computers] computers can operate as programmable user stations. They can be used as interface processors only after the development of the appropriate hardware and software for enabling compatibility with YeS computers. The number of user stations also includes the YeS-7920 display station which operates in the local mode or remotely through a modem of the YeS-8010 type and an MPD-2 or MPD-3. There are not less than four displays in its structure. User stations are connected to the VTsKP by means of switched and unswitched telephone (TF) and telegraph (TG) communication channels via modems and UPSTG's. The YeS-8001 modem makes possible the transmission of data through a telephone channel at a speed of up to 200 bits/s, the YeS-8006 to 1200 bits/s, the YeS-8010--600, 1200 or 2400 bits/s, and the YeS-8015--2400 and 4800 bits/s. YeS-8001 and YeS-8005 modems are connected to communication channels between the user station and collective-use computing center in a 2-wire circuit, and YeS-8010 and YeS-8015 in a 4-wire. All modems can operate through municipal lines. Structurally, modems or UPSTG's are included in the structure of the user station. A UPSTG is included in the structure of an MPD and modems are installed separately from MPD's or PTD's. UPSTG's can operate only through unswitched telegraph communication channels. Call devices of the YeS-8061 type are connected to modems for communication through switched telephone channels. Selection of the composition of user station equipment and VTsKP teleprocessing facilities includes the following steps:

1) The formation of tasks and their classification according to teleprocessing modes (package or interactive) and modes of interaction with the VTsKP (user station - computer, computer-computer, user station - computer - user station, etc.).

2) Determination of the volume-time characteristics of teleprocessing tasks, including the volume of input and output information for each user, the permissible time for the forwarding of information for each mode, methods of preparing and checking input and output information, etc.

3) Selection of the makeup of the software to implement users' tasks and of routes for the teleprocessing of information at the VTsKP, and specialization of the computer in solving individual groups of users' problems (package teleprocessing, interactive teleprocessing in the time-sharing mode or automated data banks, etc.).

4) Determination of the composition of user station equipment and other data preparation equipment for each user, and the selection of the types and number of user stations.

5) Selection of the configuration of the user's network and types of communication channels and circuits for linking them with user stations and the VTsKP.

6) Calculation of the number of connecting lines between the VTsKP and municipal or international telephone or telegraph exchanges.

7) Selection of the types and calculation of the number of VTsKP information teleprocessing facilities (UPSTG's, modems, MPD's or PTD's, etc.), and of the circuits for connecting them to the computer.

8) Determination of terminals for controlling operation of the user's network.

Performance of the first step is obligatory, since the entire variety of users' tasks is broken down into individual groups which are homogeneous from the viewpoint of the modes employed for further specialization of computers in solving them. After the classification of tasks it is possible to proceed to a determination of their volume-time characteristics. The load must be estimated for the task as a whole and with the segregation of its value for the 24-h period of maximum load, and within it for the hour of maximum load. The value of the latter is important not only for selecting the user station, but also for the carrying capacity of the data transmission channel between the user and the computing center. Furthermore, it is desirable to determine the load not only for the period of the introduction of the task, but also for remote periods, e.g., two to three years in advance, in order to allow for future development of the user network.

In teleprocessing the volume of information transmitted through the communication channel at the hour of maximum load (V_{chnn}) equals the annual volume multiplied by the concentration factor, which equals K_k = 0.0008 or 0.0012 for single-shift or 2-shift operation of the user station, respectively.

Knowing the particulars and the volume-time characteristics of the load, it is possible to solve the problem of the composition of the software for implementing user tasks. Here it is necessary to select the telecommunication methods of access to YeS computers, the system software of YeS computers, as well as standard and individual software for information teleprocessing. At the development stage it is necessary to be oriented to the maximum toward system solutions for YeS computers enabling the development and flexible expansion of information teleprocessing hardware and software under conditions of a VTsKP and its users. An extensive set of facilities is recommended for VTsKP's, e.g., the KAMA package of programs to support working with domestic user stations.

A promising solution to problems relating to remote access to VTsKP resources is the use of the general telecommunications method of access (OTMD), which has advanced facilities for users to work with all types of user stations in the user station - computer mode with the interactive or package teleprocessing of information, including system facilities for data acquisition and engineering communication facilities in the user station - computer - user station mode.

Only the OTMD sustains operation in the time-sharing mode, and the combined implementation of this mode with other tasks performed by the OTMD is made possible. At the present time on the basis of the OTMD intercomputer communication facilities have been developed which are used in the statistical data teleprocessing system (STOSI), in the exchange of information in the computer-computer mode and in remote access to the ASGS [Automated System for State Statistics] ISKHOD [Integrated System for the Storage and Processing of Information] remote automated data base in the user station - computer - computer mode. This system has been introduced at the USSR Central Statistical Administration Main Computing Center, the Ukrainian SSR State Statistical Administration Republic Computing Center and at the republic VTsKP's of the Belorussian SSR and Estonian SSR central statistical administrations.

It has been demonstrated in practice that it is advisable to have the computers of a VTsKP specialize in terms of classes of problems solved. Here it is possible to use as a basis the fact that on average a single computer of a class not lower than the YeS-1033 with an on-line memory with a capacity of not less than 1 Mbyte is able to serve up to 30 user stations. Solution of the problems presented makes it possible to proceed to selecting user stations and the VTsKP's teleprocessing facilities. First, on the basis of the nature of tasks and of the load per mode, it is necessary to select the types and number of user stations. The experience of the first VTsKP's has demonstrated that in the automation of tasks at enterprises and in organizations with a number of workers of about 1000 it is a good idea to have several user stations, in a number of cases of different types: Some are oriented toward the package information teleprocessing mode and others to the interactive mode of communicating with the VTsKP's automated data base. A determination is made for each type of user station of the amount of information to be transmitted at the hour of the maximum load (V_{chnn}).

Knowing the value of V_{chnn}, it is possible to determine the required carrying capacity of the data transmission channel from the user station to the VTsKP, using the inequality $V_{chnn} \leq S_{pd}$, where S_{pd} is the value of the operating carrying capacity of the data transmission channel. In the case when the delay time for messages circulating between the user station and VTsKP is limited, the required carrying capacity of the data transmission channel is determined by the equation: $\hat{S}_{pd} \simeq \ell/t \cdot (1 + \lambda t)$, where ℓ is the mean length of messages in characters and λ is the combined rate of messages of length ℓ at the hour of maximum load. Let us note that without taking t into account the value of $S_{pd} = \lambda\ell = V_{chnn}$. On the basis of these values S_{pd} is found--the carrying capacity of the data transmission channel--and from it the type of communication channel and the required transmission speed and, consequently, the type of modem or UPSTG for the user station.

This procedure is applicable both to user stations with a single-point and a multipoint connection. Under the heading of the former come, for example, the AP-1, AP-2, AP-61, AP-62 and AP-70 and of the latter the AP-4, AP-63, AP-64 and the like. The number of peripheral units in a user station of the second type, e.g., the number of displays or other data input/output units, is calculated from the number of people working with the VTsKP in the teleprocessing mode. It is desirable to provide one standby display for every 10 displays.

The circuit for connection between all user stations and the VTsKP is worked out at the fifth step. It is necessary to take into account existing standards for the utilization of communication channels. When, for example, for a switched communication channel at the user station end its utilization is greater than 0.1 erlang (hour-busy states), it is necessary to use physical connecting lines between the user station and VTsKP. Problems of the sixth step are solved after the types and number of user terminals have been selected and the method of connecting them to the VTsKP. The main problem among these is calculation of the number of connnecting lines between the VTsKP and urban and long-distance telephone or telegraph exchanges.

Based on the results of solving the preceding problems, it is possible to proceed to the calculation of VTsKP data teleprocessing facilities. The number of modems is determined by the sum of the number of unswitched and switched telephone and telegraph communication channels taking into account the probability of failure in a connection. Each user station must obligatorily be connected to a modem of the same type at the VTsKP operating at a single speed. The number of UPSTG's is found similarly. The MPD or PTD is selected from the number and type of modems and UPSTG's taking into account the particulars of the user stations served. If the number of communication channels is less than 30, then it is possible to use various combinations of MPD-1A's and MPD-3's, and if it is greater than 30, MPD-2's or PTD's are better.

Taking into account the reliability of MPD's, it is advisable to strive to select them so that the number of multiplexers of the same type will be not less than two. For the VTsKP's which have been created it is best to use MPD-2's. After the choice of data teleprocessing facilities has been completed, it is possible to estimate how many users will interact simultaneously with the VTsKP:

$$K = \frac{n\alpha_{\text{нк}}}{1 + \alpha_{\text{нк}}} + \sum_i \alpha_i (1 - P_{\text{отк}}),$$

where n is the number of user stations operating through unswitched communication channels; α_{nk} is the mean utilization of communication channels in erlangs (in hour-busy states); α_i is the total load in erlangs for the i-th group of switched communication channels from the user station to the VTsKP; and P_{otk} is the probability of failure in establishing a connection.

This figure to a certain extent makes it possible to characterize the effectiveness of design solutions for the user's network and teleprocessing facilities. As

$(k - m)/n \rightarrow 0.5$, it is possible to consider the choice of VTsKP hardware and its users satisfactory; here $m = \sum_i \alpha_i x$ is the number of switched channels occupied.

Determination of the type of control terminal completes the selection of VTsKP teleprocessing hardware. Know-how gained in the operation of a VTsKP and STOSI [system for teleprocessing of statistical information] has demonstrated that as this terminal it is a good idea to use one of the displays of the local display station connected to the computer, solving the problem in the teleprocessing mode. Stations of the YeS-7906 or YeS-7920 type are used for this purpose, in which one display serves the computer operator and the second can be assigned to the VTsKP's data teleprocessing administrator. In the case when the teleprocessing mode is carried out at the VTsKP by several computers which have not been formed into a complex or do not operate under the control of an operating system of the ROS [distributed operating system] type, then an independent teleprocessing administrator terminal must be provided for each computer.

In the equations presented above a number of standard factors have been used, which have been obtained on the basis of experience in solving problems for YeS computers and which are recommended for use in calculating the amount of hardware (table 2).

Table 2. Standard Factors for Calculating Hardware Complex

Conventional symbol	Quantitative value	Conventional symbol	Quantitative value
For accounting problems, γ	500 operations/character	K_p	1.2
For planning problems, γ	5000 operations/character	K_k	0.0008 for single-shift operation; 0.0012 for 2-shift operation
For optimization problems, γ	20,000 operations/character	P_{otk}	0.02
γ_{ks}	100 operations/character	S_{pd}	4000 in a subscriber's telephone network; in a general-use telephone network, charac./h: 6000 for 200 bauds; 40,000 for 600 bauds; 80,000 for 1200 bauds; for unswitched telephone channels, charac./h: 800,000 for 2400 bauds; 1.6 million for 4800 bauds
γ_z	700,000 operations/character per request		
K	2.4		
K^{sp}	0.96		
K^{g}	0.75		
K^{n}	2		
η^{m}	0.6		

Example of Calculation of a VTsKP Hardware Complex

Starting Data

Volume of input information--Q = 9 million alphanumeric characters; volume of input/output information in exchange through communication channels--Q_{ks} = 19 million alphanumeric characters; number of requests--N_z = 3500; volume of information to be transferred from documents to media--Q_p = 3.1 million alphanumeric characters; volume of information to be stored in external memories--Q_x = 1.78008 billion alphanumeric characters; number of users--100.

The values of standard quantities presented in table 2 are used in the calculation.

Calculation of Hardware Complex

1. Calculation of Number of Computers

Conditions: The volume (Q) of input information is distributed by tasks: accounting--60 percent, planning--30 percent, optimization--10 percent; T_s = 15 h .

Volume of computing operations for solving routine problems--$R_r = 500 \cdot 0.6 \cdot 9 \cdot 10^6 + 5000 \cdot 0.3 \cdot 9 \cdot 10^6 + 20{,}000 \cdot 0.1 \cdot 9 \cdot 10^6 + 100 \cdot 19 \cdot 10^6$ = 36.1 billion operations/s . Amount of computing work in fulfilling requests--$R_s = 3500 \cdot 700 \cdot 10^3$ = 2.45 billion operations/s .

Required performance of computer complex:

$$V_{tr} = \frac{(36{,}100 + 2450) \cdot 10^6 \cdot 2.4}{15 \cdot 3600 \cdot 0.75 \cdot 0.96 \cdot 2} = 1.1 \text{ million operations/s} .$$

For the VTsKP it is advisable to use YeS computers of the following types: YeS-1045, YeS-1055 and YeS-1065 with a speed of response of 880,000, 450,000 and 5 million operations/s, respectively. We select a complex of two computers of the same type, YeS-1045's (V_{EVM} = 880,000 operations/s), satisfying the requirement $V_{EVM} \cdot n \geq V_{tr}$ $(0.88 \cdot 2 \geq 1.1)$.

2. External Memories

The volume of information to be stored (Q_x) is distributed over memory units in the following manner: 22 percent in YeS-5061 disk units, 64 percent in YeS-5066 disk units and 14 percent in YeS-5017 tape units.

For YeS-5061 disk units (29 Mbytes):

$$N_v = \frac{403.68 \cdot 10^6}{29 \cdot 10^6 \cdot 0.6} = 23.2 \simeq 24 \text{ YeS-5061 units} .$$

For YeS-5066 disk units (100 Mbytes):

$$N_v = \frac{1164 \cdot 10^6}{100 \cdot 10^6 \cdot 0.6} = 19.4 \simeq 20 \text{ YeS-5066 units .}$$

For YeS-5017 tape units (20 Mbytes):

$$N_v = \frac{212.4 \cdot 10^6}{20 \cdot 10^6 \cdot 0.6} = 17.7 \simeq 18 \text{ YeS-5017 units .}$$

3. Data Preparation Units

The volume of information to be prepared (Q_p) is distributed by type of medium as follows: 80 percent on tape, 20 percent on punched cards. The operator's production standard is $H_v = 6100$ alphanumeric characters/h ; $T_p = 15$ h .

For units of the YeS-9001 type:

$$N_{p_{m/1}} = \frac{2.1 \cdot 10^6 \cdot 1.2}{6100 \cdot 15} = 27.6 \simeq 28 \text{ YeS-9001 units ,}$$

or two multiconsole data preparation systems of the YeS-9003 type (16 consoles each).

For units of the YeS-9011 type:

$$N_{p_{p/k}} = \frac{1 \cdot 10^6 \cdot 1.2}{6100 \cdot 15} = 13.2 \simeq 14 \text{ YeS-9011 units .}$$

4. User's Network to be Designed

This includes 100 users, 25 of which are supplied with AP-4's, 25 work with AP-64's and 50 have AP-1's. Each AP-4 and AP-64 is characterized by a request rate of $\lambda = 40$ requests/h , for which the mean volume of information transmitted, including the response, equals $\ell = 1000$ characters ; furthermore, the mean time for attending to a request must be about $t = 0.0011$ h . For all AP-1's operating through switched channels the total utilization equals $\alpha_i = 22$ erlangs with $i = 1$. For each AP-4 and AP-64 the value of the nominal carrying capacity of the data transmission channel is calculated as $S_{pd} = 1000/0.0011 \times (1 + 0.044) \simeq 900{,}000$ characters/h . According to table 2, for each of the user stations indicated a data transmission channel is selected with a speed of 2400 bits/s with YeS-8010 modems. The mean number of user stations which simultaneously communicate with the VTsKP equals $K = 50 \cdot 0.05(1 + 0.05) + 22 \cdot 0.98 \simeq 24$ terminals . Thus, the connection to the VTsKP of 100 user stations is possible, 24 of which will operate simultaneously.

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IMPROVING THE ECONOMIC MECHANISM IN USSR CENTRAL STATISTICAL ADMINISTRATION'S COMPUTER NETWORK

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[Article by M. Osipov]

[Text] The 12 July 1979 CPSU Central Committee and USSR Council of Ministers decree "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality" places on the agenda the need to resolve a number of serious problems connected with improving the management of the USSR Central Statistical Administration [CSA] system in computer organizations at the rayon, oblast and republic levels. And, as is known, today the computer network of the USSR CSA numbers almost 3,000 computer centers and stations located on different parts of our country.

It should first of all be noted that the existing system for planning the work of the USSR CSA computer network does not, in our view, meet today's requirements since it does not insure the most efficient ways for achieving high final results, the combination of long-term and current plans, or balance in economic indicators. For example, the plan for the volume of work sometimes includes actual expenditures of machine time instead of normative time spent to solve a given problem. This leads to a situation in which it is more advantagoeus for the computer center to use obsolete, labor-intensive equipment on which much machine time is spent. Another example: the volume of work is planned by proceeding from operator work on a time-spent basis, which also fails to promote better utilization of computer equipment and so forth.

The lack of long-term plans for the development of the computing organizations at all levels of the USSR CSA computer network has led in practice to serious miscalculations. Thus, everywhere a disproportion has been allowed between normatives for the periods assigned for assimilating computers and the periods allowed for providing them with software. In recent years several attempts have been made to develop methods for compiling annual production and financial plans for computer organizations but this work also has not been brought to a conclusion.

These methods are designed for individual sections of the plan and do not provide for plan balance or take into account the features of production and financial plans for at the different levels (rayon, oblast and republic). Moreover, as a rule,

virtually no use is made of the mandatory, scientifically substantiated normtive indicators for the entire system when plans are compiled: the factor of objective approach to evaluation of results of activity, and determination of realistic tasks for the development of the computer system as a whole and for its individual subdivisions.

In our opinion, the restructuring of the system for planning the work of computer centers should be as follows. First of all it is essential to determine and accurately formulate indicators (planned and calculated) for all organizations in the USSR CSA computer network, and also to work out and confirm for them a form for production and financial plans as is done for industrial enterprises or sovkhozes, including in it algorithms for calculating individual plan indicators in order to avoid lack of coordination in computing them.

It is necessary to introduce additional indicators for evaluating the comprehensive development of organizations, including the solution of social problems, as, for example, norms for the expenditure of assets on labor protection and safety equipment, capital investments for the construction of new and expansion of existing production premises, social and everyday projects, and housing and hostel construction, including under conditions of shared participation.

A review should be made of the expediency of centralizing in special funds of computing organizations that are operating profitably the assets that under existing legislation are directed for housing construction and social and cultural measures, having examined the utilization of these funds for goal-oriented purposes, within the plans. This is a very realistic source for creating better working and leisure conditions for workers in production collectives.

It is essential to introduce on a mandatory basis plan indicators for the introduction of progressive equipment and more productive computer equipment. It should be noted that up to now the computer organizations at the oblast and rayon levels of the CSA do not have plans for the introduction of scientific developments or new equipment.

On the practical plane, when equipment, for example, sets of electronic equipment for statistics, is introduced, only the period for its introduction is planned while a long list of questions included in this entire complex of work, such as the availability and training of personnel, the technical base, means of communication, material and financial backing, and compensation for the period of assimilation for the new equipment both by the computer center and by the workers remains "on the side."

Plan indicators designed to influence the regime of thrift require some change. Thus, in practice, of all the numerous articles of expenditure, only the wages fund and the amortization fund are planned while all other material expenditures in the plan are not alloted but merely reflected in the total results as "other expenditures." However, they make up a considerable sum. For example, for the computer organizations in the Kazakh SSR CSA they comprise R3.5 million, or almost 14 percent of expenditures.

The lack of plan indicators (or normatives) for the expenditure of materials, fuel, electric power and other production costs is leading to a situation in which questions

connected with the regime of thrift in material resoucres and monetary assets are lost to the view of direct planning regulation (management).

In the above-mentioned decree, strengthening the role of the five-year plan is defined as the main element in improving plan indicators and criteria for assessing the results of activity. Today, a real opportunity exists for immediate resolution of these problems in the CSA computer system, and for this it is essential to introduce immediately at all levels of economic management a system for summing up work results and evaluating plan fulfillment, as established in the decree; that is, fulfillment of the five-year plan with increasing results from the start of the five-year plan, and fulfillment of the annual plan with growing results from the start of the year.

The appropriate corrections should also be introduced in assessment of plan fulfillment when summing up results of socialist competition and in the regulations for awarding bonuses.

It would be necessary to introduce into practice and widely develop the adoption of counterplans by the collectives of computer organizations. Many collectives at computer organizations have at their disposal large reserves for expanding both the range of work done and the comprehensive nature of this work.

At present, initiative by computer organizations to expand mechanized work rarely leads to simultaneous or sharp increase in the volume of work, and hence, to stepped-up or even enhanced plans for the following year.

If long-term (5-year) normatives are worked up and introduced in the computer organizations for growth rates in the volume of work, labor productivity, circle of clients, comprehensiveness in fulfillment of mechanical work, load-factors for computer equipment and profitability, their interest in adopting counterplans that exceed the five-year plan targets would be enhanced.

As is known, the most substantial feature in the planning system is the transfer to planning of net output (from the normative for production costs), bearing in mind that this system of indicators will orient labor collectives and all management and planning organs on improving final national economic results, increasing return from labor and equipment, and careful, rational utilization of resources.

The practice that has existed for many years in handling accounts with clients for completed mechanized processing of calculation, planning and engineering data is based on the normative cost of the work, which under conditions of the CSA computer system can exert the same effect as the transfer to planning of "net output" in industry.

The existing price list for calculations for work done on computer perforators and keyboard machines and calculations for labor-input and plan calculations for costs for work done per punchcard machine or other unit of equipment takes into account precisely the normative of work costs. The price list of 14 April 1981 alone--"Rates for Computer Center Services"--has sharply changed the calculation principle: instead of normative costs for work done provision is made for calculations done from actual expenditure of machine time.

The computer operations section is interested in increasing machine up time (for each percentage point of increased machine up time bonuses are 3 percent in accordance with point 4 of the "Standard Regulations on Awarding Bonuses). This kind of direct dependence between the sizes of the bonuses as a function of machine up time rather than bonus as a function of final results of the problem solution, creates interest in using those versions of software that require large amounts of machine time (because using a better set of software that insures a considerable reduction in machine up time also reduces the size of the bonus), and in decentralizing the preparation of technical data medium, where the worse it is prepared at the oblast level the more advantageous it is for the rayon computer center or multiple-user computer centers at the oblast level, since the latter spend large amounts of machine time on monitoring and repeatedly correcting badly prepared technical mediums, with payment made, in accordance with existing instructions, by those responsible, that is, the computer centers of the oblast statistical administration, and, in fact, by using the same assets coming from the republic CSA for the development of electronic data processing [EOI] complexes.

Thus, two contradictory situations prevail:

when work is done on computer keyboard and punch equipment the client pays for normative operating time, while for the same work done on a computer he pays actual computer machine time used.

Evidently, understanding the illogical nature of these premises, normatives were confirmed for computer machine time for the processing of statistical electronic data processing complexes. But the entire paradoxicalness of the situation that has been created lies in the fact that no instructions have been given for the transfer to calculations according to normative costs for processing.

The Kazakh SSR CSA has proposed confirmation of normatives for time spent to process statistical electronic data processing complexes using computers, and on their basis to have payments made for the volume of work completed. In making payments on the basis of normatives against a precise formulation of the price list--making payment demands for actual machine time used, in a new formulation--there is much that remains vague. For example, are normatives used only for the control function or are they a calculated price? How is payment exacted for complete work: from actual expenditures within the normative limits or only from the normative, regardless of actual expenditure?

This vagueness is leading to a situation in which the client's assets for machine completed work are everywhere being taken for actual machine time used.

The existing system for calculating work done on computer keyboard and punch machines also bears little relationship to the true situation in the use of computer equipment. For example, operating time for computer keyboard and punch machines is determined by operator time on these machines, but given the same operating time for these machines, their efficiency will obviously differ, since this latter is affected, in addition to the time factor, by the following influences:

operator ability;

the organization of the technologic process, particularly at bottlenecks such as the degree of automation in the preparation of technical mediums and the forms and methods of control and output;

the number of peripherals available (external storage, punch equipment), and the configuration of equipment;

the nature of the work done (whether or not the load is spread evenly on available computer equipment or whether there are peak loads on individual pieces of equipment).

These and other defects in the existing system for calculating the load on computer equipment are explained by the fact that up to now the plan targets for equipment load are not used for planning work volumes, and important economic categories such as labor productivity and the yield on capital are considered in isolation from the indicators for equipment loading.

Thus, two indicators for the load on computer equipment are involved in the formation of the economic indicators for the operation of a computer organization: the first is total useful operating time for computers, which takes place throughout the entire existing system of accountability and is indirectly linked with the formation of economic results; and the second is machine time needed according to existing normatives and subject to payment by the client, that is, time spent.

It is obvious that this latter, normed (spent) time determines the true efficiency in the use of computers and directly (and not inidrectly) affects labor productivity, yield on capital, prime costs and profitability. At present this indicator is included neither in the plans nor in accounts, and accordingly, in order to make plans realistic and strengthen their effect in improving efficiency in the use of computers, it should be planned and taken into account, and there should be economic incentive not so much for "useful" time in computer operation ("gross" time) as for actual machine time used ("net"), presented for payment according to the norms that take into account labor input and calculations.

The use in calculations and planning of "normative (spent) operating time for computers" as a criterion for the work of a computer organization would solve a number of other very complex problems, as for example that of regulating accounts with clients for mechanized processing. When volumes of work stemming from the normative cost of processing are included in plan fulfillment there is less interest in superfluous "sections" or "extra expenses" or in using various kinds of unplanned "manual work."

One of the most important directions in improving labor management at the present stage is the universal introduction of the brigade form of labor organization. Piece-rate wages in the computer organizations of the CSA at a specific stage in the formation of production collectives have exerted a positive effect. They have promoted improvements in the technological process, enhanced labor productivity and skills, and facilitated a more rapid assimilation of productive computer equipment.

At the same time, when a large proportion of work on mechanical processing was done on computer keyboard machines, each operator was paid for the final product. As the work became more complex and comprehensive processes were set up (complexes

of electronic processing of statistical data or comprehensive mechanization of accounts), piece-work wages for operators participating in comprehensive processing became increasingly remote from the final results and accordingly the piece-work rate for intermediate operations without account being taken of final results ceased to have any positive effect and hindered any further reduction in labor input or improvement in the quality of work completed.

Existing normative documentation on questions of labor organization in the computer organizations of the CSA can be used without significant corrections for the brigade form of labor organization. Things are more complicated when it comes to solving questions of incentive.

Some 45 operators at computers centers of the Kazakh SSR CSA have been switched experimentally to the brigade form of labor organization and incentive. Here, they proceeded from the premise that the production target for a brigade would be of a final character and that it would be possible to calculate from the completed cycle the normative labor input and thus determine wages for the brigade as a whole for the final output (rather than for the list of spearate operations). When wages are paid from the final product, questions of execution periods and work quality--the main criteria for bonuses--can be precisely defined. The bonus fund for the brigade is divided among the brigade members once a month and the size of each member's bonus is determined by taking into account his actual contribution to work results.

In the early days differentiated (according to their labor contribution) time salaries were established for the brigade members in accordance with existing rates. Working self-management must be exposed in full measure in the brigade form of labor organization and incentive. By this we must mean rather more than wages for completing a total work schedule, where the role of the operators is reduced, as were to a more or less objective distribution of the amount earned.

Working self-management presupposes that operators can not only themselves participate in the distribution of work but should also decide how how many operators are needed to complete a given task (for example, four operators or five operators). The makeup of the brigade should be selected with skill, taking into account the characters of the people, particularly the brigade leader. The concept of "profitable" or "unprofitable" work means less, for the brigade is collectively interested in carrying out all the operations.

And from the standpoint of quality? Frequent conflicts now arise between controllers and operators. And here the responsibility of the operator acquires a different character. The operator is responsible not only to the administration but also to his own comrades.

Now, unfortunately, there are many unresolved questions in economic incentive for the quality of completed work. In this connection it would be necessary to resolve the question of differentiation in the wholesale [otpusknoy] cost per machine hour for computer keyboard and punch machnines and a wage rate for the operator as a function of the comprehensive nature of processing and the quality of work.

Successful restructuring of work in the CSA computer system in light of the demands of the CPSU Central Committee and USSR Council of Ministers decree of 12 July 1979 depends largely on how quickly solutions are found to questions of improving planning work, primarily the adoption of normative documents aimed at improving the operation of the economic mechanism and managment activity in the computer organizations of the USSR CSA system.

9642
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UNIFIED COMPUTER SYSTEM TRANSPORT STATION

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81 (manuscript received 13 May 81) pp 3-8

[Article by Viktor Mikhaylovich Glushkov, academician, Vladislav Vladimirovich Gusev, candidate of physical and mathematical sciences, Igor' Leonidovich Dayen, engineer, Dmitriy Ivanovich Nikolenko, senior scientific coworker, Lyudmila Viktorovna Petrukhina, junior scientific coworker, and Viktor Alekseyevich Tumko, engineer, Cybernetics Institute of the Ukrainian SSR Academy of Sciences, Kiev]

[Text] Introduction. The decision was made to segregate the data transmission system to which the subscriber computers are connected in the computer network [1, 2]. The data transmission system provides for information exchange between subscriber computers and realizes three levels of the seven-level network model: physical, line and net [3, 4]. The through delivery of communications between subscriber computers is controlled by the fourth level--the transport level. The functions of this level are realized by the system of programs available to each subscriber computer of the network and called the transport station (TS). There are numerous synonyms for this term: the network communication manager, interprocess telecommunications media, and so on [5-8].

The above-enumerated four levels form the virtual subsystem of the computer network ensuring its functioning as a united whole. It is called the transport subsystem (Figure 1). It creates the prerequisites for constructing the distributed program systems implementing the upper levels of the network software: period of communication, representative and applied.

In this article a study is made of the TS for the subscriber computers of the unified system in the operating system of the unified system.

General Organization of the Network Access Method Programs. This method is implemented using a set of programs including the TS, which is the nucleus, and the software providing the interface between the applied programs (PP) and the TS. The interface is organized by macroinstructions, the communications process and switchboard.

The TS carries the basic load in controlling the transmission and reception of dispatches through the network. It realizes the second-, third- and fourth-level protocols (line, network and transport). Each PP is executed as one step of the

assignment and can include several asynchronous network processes (problems--in the terminology of the operating system of the unified system). The network access method provides for simultaneous and independent communications with the network for different PP.

The macroinstructions of the network method of access are used in the PP for input-output operations. The communications process controls the exchange between the PP and the TS in the name of its PP. The communications process is executed asynchronously with respect to the network processes and is realized as an individual subproblem of the PP. Each PP interacting with the TS must include at least one communications process (subproblem).

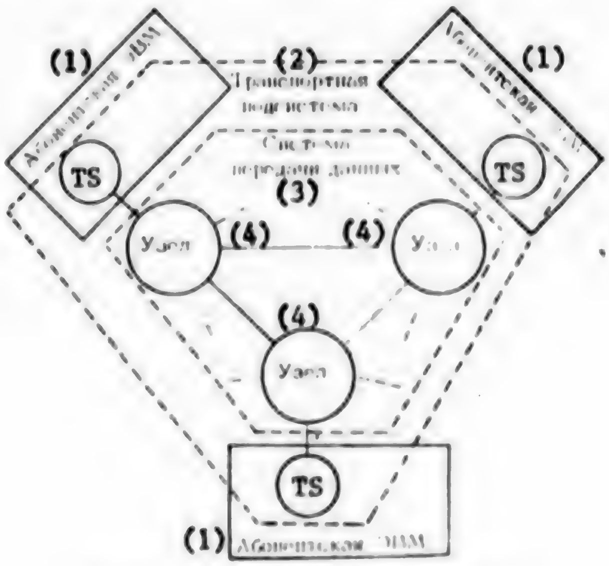

Figure 1. Computer network.

Key: 1. Subscriber computer
2. Transport subsystem
3. Data transmission system
4. Junction

The switchboard provides for exchange of data and interrupt signals between the PP and the TS which has the same status with respect to the switchboard as the PP. Inasmuch as the operating system of the unified system (OS YeS) does not have sufficiently convenient standard means of exchange between programs in different zones of the ready-access memory, a switchboard was developed on the basis of the general telecommunications access method of the OS YeS. This means of communication between different programs in a single computer is a necessary part of multiprogram operating systems.

TS Protocols. These protocols regulate the interaction between the TS and the nearest communications junctions with which the subscriber computer is connected by communications lines, between the TS and PP implemented in the subscriber computer and also between the given TS and other TS in remote subscriber computers. On the basis of these protocols encompassing levels from the first to the fourth, interaction between the remote network processes is organized which is determined by the protocols of the fifth, sixth and seventh levels (see Figure 2).

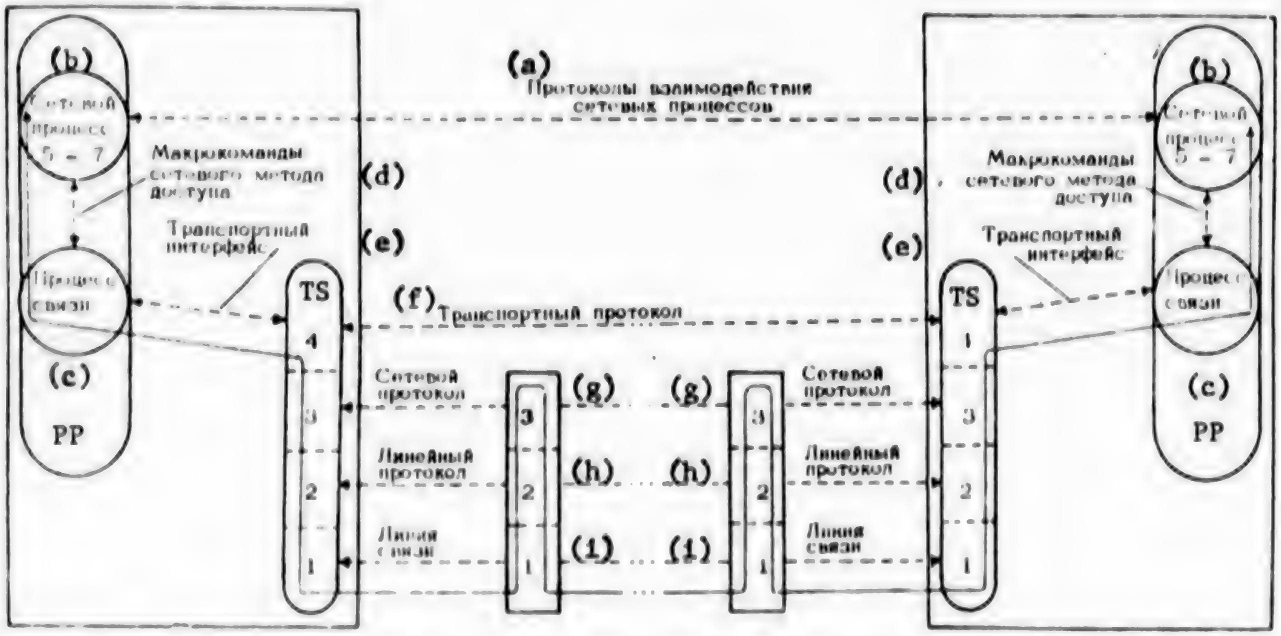

Figure 2. Protocol structure and organization of process interaction in a computer network (the numbers indicate the levels, the solid line indicates the path followed by the communications between the network processes).

Key:
- a. Network interprocess protocols
- b. Network process 5-7
- c. Communications process
- d. Network access method macroinstructions
- e. Transport interface
- f. Transport protocol
- g. Network protocol
- h. Line protocol
- i. Communications line

The protocol for the first level is hardware implemented. Each subscriber computer can be connected by segregated telephone lines with several communications junctions or other subscriber computers. A data transmission multiplexor (MPD-3) with synchronous adapter (SA-2) is used as the communications equipment for the unified system of computers.

The line protocol constructed on the basis of the base telecommunications access method of the operating system of the integrated system determines the communications lines management procedure. The network protocol regulates the coupling of the TS to the packet switching datagram network [4]. Variations of the line and network protocol caused by replacement of the communications equipment or connecting a subscriber computer to another type of data transmission network (for example, to the X.25 network) are permitted.

The transport protocol which plays the leading role among the TS protocols was developed on the basis of the international network protocol INWG-96 [9]. It provides for exchange of communications between different TS in the transaction modes and virtual connection to the error monitor and traffic control.

The transport interface was developed for coupling the TS and PP through a switchboard. The communications process serves as the means for implementing it on the PP side. Two goals are achieved using the transport interface: the structures of the TS and communications process become independent of the specific execution of the switchboard; the TS can be coupled out from the subscriber computer to the communications junction or buffer processor constructed on the basis of a minicomputer or microcomputer.

Traffic Flows in the TS. The structure of the data flows through the TS is determined in accordance with the above-mentioned protocols. The second-level flows are transmission and reception of frames over the communications lines. The third-level flows are reception and transmission of packets between the TS and the communications junction. The fourth-level flows are reception and transmission of the transport protocol instructions between different TS and also exchange of transport interface instructions between the TS and the PP communications processor.

The messages between the network processes in the different subscriber computers are transmitted through a chain: the network process--communications process--TS--data transmission system--TS--communications process--network process. Interaction of the network processes in one subscriber computer is possible by the following scheme: network process--communications process--TS--communications process--network process.

The following TS units are used to control these flows: communications lines (second level), connections, ports, letters, interrupt signals (fourth level). Each of the mentioned units is determined by its control unit and program module giving the rules for controlling this unit.

Let us note that the third-level flows are processed by programs for shaping dispatched packets and analysis of the received packets. In the TS there are no third-level units inasmuch as the datagram protocol does not provide for packet flow control. The only actual function of the third level performed in the TS is packet distribution with respect to different communications lines (if there are several).

Connection plays an important role in providing reliable communications between the TS and the PP. It has a local name by means of which the TS identifies the PP. For each active connection, some number of port, letter and interrupt signal controllers are segregated which the given PP has a monopoly on the use of.

The TS monitors the operation of the PP by means of the switching. Any violation of the transport interface protocol of which the PP is guilty is detected and implies disconnection of the corresponding PP or TS. All of the port, letter and interrupt signal modules assigned to the given connection are then released. Normal or emergency completion of the assignment step and also completion of a subproblem within the framework of which the communications process is executed also leads to automatic disconnection of the PP or TS.

The flows between PP and TS are managed independently for each connection. At the same time, the possibility of improper use of the buffer space both in the PP

and in the TS is eliminated (there is no overflowing of the buffers, blocking, loss of messages, and so on).

Thus, by using the connection, the correspondence is established between the operation units adopted for the given operating system (applied assignment, assignment step, problem) and the units by which the TS operate and which remain invariant in essence for different subscriber computers (network process, port, letter, interrupt signal, input-output buffer). One PP can interact with TS using several connections.

Each connection corresponds to a separate communications subproblem (process), the priority of which is higher than for the other problems of the given PP. In accordance with the structure of the transport interface, the connection is divided into two semiduplex channels. Over one channel the instructions are transmitted from the PP to the TS, and the responses are returned from the TS to the PP, and over the other channel, vice versa.

The responses to the instructions are sent immediately, that is, no additional input-output operations are performed between reception of an instruction and sending a response. This ensures a high degree of synchronization of the PP and the TS. Each PP instruction contains one user directive transmitted to the TS for processing. The TS responses usually have the following semantics: "TS has begun processing of PP directive," "TS has rejected PP directive" or "PP directive contains an error, PP is disconnected from TS."

The semantics of the TS instructions for the PP are as follows: "Processing of PP directive completed," " Take the required letter fragment for sending to addressee from the PP buffer" or "Distribute the fragment taken to the PP buffer." The PP response to the SELECT FRAGMENT instruction will be the text of the required fragment transmitted by the communications process from the PP buffer to the TS. When processing the DISTRIBUTE FRAGMENT instruction, the communications process places the fragment in the receiving buffer of the PP and returns the response "Fragment accepted" to the TS. The semantics of the PP responses to other TS instructions are unique: "Instruction received."

A port is used to control exchange between different network processes, and it is an analog of the set of data by means of which the read and write operations are performed. On interaction of two network processes, at least one port from each process side is used. One PP can conduct data exchange through several ports. The network processes are identified by using common names of ports uniquely defining each port in the overall transport subsystem. The PP gives the port conditions (transactions or virtual connection) when it is opened.

A letter has a text up to 27,648 bytes long, and it is the basic information unit sent between the network processes by means of the TS. The received and dispatched letters are processed by fragments. As a result, a small number of fragments (up to 10) are simultaneously in processing in the TS, at the same time as there can be several dozen simultaneously dispatched and received letters of the above-indicated length. The buffers required to store the complete texts of these letters are located in the PP ready-access memory. Proper arrangement of the fragments in the buffer is ensured by the communications process which

determines the position of the fragment with respect to its displacement relative to the beginning of the buffer. Accordingly, the TS can transmit fragments of the letters to the PP buffer or request them from it in arbitrary order, indicating the displacement of each fragment relative to the beginning of the buffer.

The interrupt signal, just as the letter,is a dispatch, but with a text of fixed length equal to two bytes. In addition to text transmission, the interrupt signal performs specific operations, for example, it initiates the interrupt processing program in the addressee PP, it clears the buffers for reception and dispatch of letters, and so on. The interrupt signal corresponds to the transport protocol command "Clear connection."

Multiplexing the data flows is an important function of the TS. The TS units are assigned common and local names. By using the common name each unit is uniquely identified in the entire computer network, and the local name uniquely defines the unit with respect to the given TS. Each unit is used when processing strictly defined forms of dispatches. For example, the port plays a significant role in processing the instructions of the transport interface received from the PP such as OPEN PORT and CLOSE PORT. The port is used for dispatching and receiving transport protocol instructions SET UP VIRTUAL CONNECTION and BREAK VIRTUAL CONNECTION. The letter dispatch control module is needed for dispatching fragments of a letter, and so on.

The traffic flows are distributed in the TS by comparing the common and local names of the dispatches with the corresponding names of the TS units and also with the names of the network processes of the sources and the addressees. (The name of the corresponding port serves as the name of the network process.) The structure of the common name is determined by the transport protocol, and the structure of the local names, by the line- and network-level protocols and also the transport interface.

Dispatcher and TS Processes. The TS program is constructed as a set of quasi-parallel processes controlled by the TS dispatcher. On the whole, this program is executed as one applied problem of the operating system of the integrated system. Each process corresponds to a defined TS unit. The process control module is simultaneously the unit control module and is divided into two parts: common, identical for all processes, and special, corresponding to a unit of a defined class.

The TS dispatcher includes input and output modules, an external events analyzer, signal processing subroutines, subroutines for analyzing the state of the activated processes, macroinstructions and TS process control subroutines. The dispatcher realizes communications with the OS YeS and performs exchange operations over the communications lines and with the PP using the OS YeS macroinstructions.

The external events analyzer determines the type of event (completion of an input-output operation, operator instruction, time interrupt), and it transfers control to the corresponding input signal processing subroutine. In turn, this subroutine finds the processes which the input signal can be transmitted to for processing, thus performing the function of demultiplexing of the incoming flows. After the corresponding processes are found (or created), the subroutine for

analyzing the state for each activated process is called. This subroutine modifies its controller and activates the process from a defined point in the program.

The processes are returned to the TS dispatcher using the macroinstructions for controlling the process queues, forming and dispatching messages to the PP or over the communications line, halting the process for a defined time or on completion of some event, the creation of a new process, activation or cancellation of a process, and so on. There are also macroinstructions for transmitting signals from one process to another.

The TS processes are executed as coprograms. The process to which the TS dispatcher has transferred control is called the current process. It has access to all structures of the station data, its operation cannot be interrupted until it returns control to its dispatcher. Therefore there is no necessity for semaphores or other means of regulating access to the TS data structures collectively used by different processs. In particular, the current process can alter the contents of the controllers of other processes. The current process returns control to the dispatcher in the following situations:

a. the process gets into the message output queue for the communications line or to the PP;

b. the process is delayed for a defined time interval;

c. some external event is being waited for;

d. the process self-cancels.

The current state of the process (direct execution), active state (the process is in the activation queue and ready to go into the current state), and also the state of waiting for activation under any condition are possible.

The process is converted from the waiting state to the active state by one of the following input signals (events):

a. completion of exchange over the communications line or with the PP;

b. completion of a time-out;

c. operator directive.

Each waiting state has its number characterizing the type of signal expected by the process. In this sense each class of processes is described by a finite automaton, the states of which correspond to the waiting states. The transfer and output tables of the automata are used not only to construct the program, but also to verify the TS protocols.

The TS processes can be divided into classes corresponding to types of TS units: connection, ports in the transaction mode and in the virtual connection mode, letter dispatching, letter reception, interrupt signal dispatching (the interrupt

signal is received by the port process), line control. There are also classes of auxiliary processes.

In the TS there are no processes corresponding to the network protocol of the datagram network, inasmuch as this protocol does not provide packet flow control.

The processes of the first six classes are organized into trees (families). The root of the tree is the connection process, its sons are the port processes, its grandsons (the sons of the port) are the processes of the remaining three classes. On completion of a port process or connection, the corresponding subordinate processes are automatically completed.

General Telecommunications Access Method as a Means of Exchange Between PP and TS. In the first version of the network access method, the general telecommunications access method (OTMD) was used as the switchboard. The developers refrained from creating a network access method directly based on the OTMD for the following reasons:

a. the OTMD does not provide dynamic alteration of the names of the destination queues (analog of ports), these names are rigidly fixed when starting the PP;

b. the traffic flow management is not reliable: the messages can be lost inside the traffic control program (PUS) of the OTMD on overflow of the buffers, which is inadmissible even under the condition of warning the PP of such losses;

c. creation of the TS for the unified computer system pursued a more general goal--the development of a general approach to the construction of the network access method independently of the type of subscriber computer.

The PUS of the OTMD is executed in a separate zone (section) under the control of the operating system of the unified system and uses its own system for identifying the user programs by the names of the destination queues. The TS is executed as a subproblem of the PUS of the OTMD and is an ordinary user program with respect to it.

The PP executed in other sections interact with the TS through the PUS of the OTMD and their communications processes, each of which must open one input and two output sets of data for exchange with the PUS of the OTMD. The second output set is used to record messages on disconnection of the PP from the TS. This message is formed at the time of connection of the PP to the TS and is delayed in the buffer of the PUS of the OTMD. In case of normal or emergency completion of the subproblem (communications process) the operating system closes the corresponding three data files, and a message that the PP is disconnected is automatically transmitted to the TS by means of the PUS of the OTMD. The TS records disconnection of the PP and releases all the controllers of the processes of the family of the given connection.

Means of modifying the names of the destination queues of the PUS of the OTMD were developed. This simplified the training of the assignment control operators needed for communications between the PP and the PUS of the OTMD: any applied assignment includes three standard DD-operators with fixed names of the destination queues.

The various PP are connected to the TS in series, with preliminary placement of each PP in the queue for the special systems virtual reserve (macroinstructions ENQ, DEQ in the operating system of the unified system). The TS makes the required modification in the terminals table of the PUS of the OTMD, assigning the above-mentioned standard names to the free triplet of destination queues before these queues are isolated by the next PP connected to the TS. Thus, under the conditions where the PP does not know the names of all of the free destination queues, and all the destinations are equivalent, dynamic manipulation of the terminals table on the part of the TS permitted realization of the required means of "group" naming of the destination queue.

Network Access Method Macroinstructions. These macroinstructions are used to transmit user directives to the TS and to check the execution of these directives. The general system for the PP to reference the TS consists in the following. One of the PP problems (the PP network process) transmits directive parameters to the communications process (subproblem) as a result of execution of the macroinstruction. (The events hardware of the operating system of the unified system is used to synchronize problems.) The communications process forms the transport interface command and transmits it to the TS via the switchboard, and the network process delays until receiving an answer from the TS. The execution of the macroinstruction of the network access method is completed by the fact that the TS returns a response to the communications process, which informs the network process of successful initialization or emergency termination of the processing of its directive.

The macroinstructions OPEN (CLOSE) PORT, DISPATCH (RECEIVE) LETTER, CLEAR CONNECTION are executed by this scheme. When executing the macroinstruction CONNECT TO TS, the communications process is formed, and on execution of the macroinstruction DISCONNECT FROM TS, the communications process is canceled.

After receiving the transport interface instruction PROCESSING OF THE PP DIRECTIVE COMPLETED from the TS, the communications process establishes the event and the code for execution of this directive to which the network process receives access after execution of the standard macroinstruction of waiting for an event of the operating system of the unified system.

Estimating Memory and Output Capacity of the Network Access Method. The network access method was developed for the version 6.1 of the OS YeS and higher versions. The maximum number of connections, ports, letters, interrupt signals and communications lines simultaneously serviced by a station is determined in its generation phase. As an example let us present a version of the TS with the following technical specifications:

Required size of memory zone for the PUS of the OTMD and TS	120K bytes
Including:	
For the PUS OTMD	90K bytes
For the TS	30K bytes
Number of connections	4
Total number of controllers, ports, letters and interrupt signals in the TS	20
Number of 216-byte buffers in the TS for fragments of letters	10
Number of lines	1

No external memory is used for operation of the TS. About 3K bytes of ready-access memory is required in each PP for the communications program and its tables.

The overhead connected with processing the TS messages depends on the output capacity of the computer, and for sufficiently powerful computers (YeS1040 and higher) the overhead is small by comparison with the transmission time and message delay in the communications lines. The operation of the PUS of the OTMD is felt negatively in the TS characteristics: dynamic calling of the OTMD modules from external memory takes place during exchange with the PP, which is entirely unnessary from the point of view of transporting data inside the on-line memory.

Conclusion. At the present time a switchboard has been developed on the basis of the "Pochta [post office]" system which permits exclusion of the PUS OTMD from the network access method and reduction of the total ready-access memory from 120K bytes to 40K bytes. The communications process can be replaced by a set of asynchronous procedures which will simplify implementation of the network access method.

Further improvement of the TS protocols will increase the efficiency of using the communications lines which are the "bottleneck" of the telecommunications systems. In particular, the length of the titles of the transport protocol instructions has been decreased. Additional types of servicing can be realized in the TS in the virtual connection mode, in particular, encoding the texts of letters and processing multifragment packets.

The transfer of the TS to minicomputers or microcomputers unloads the subscriber computers and facilitates development of the network access method for computers not compatible with the unified computer system.

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10845
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PROBLEMS OF PRACTICAL CONSTRUCTION OF REGIONAL COMPUTER CENTER NETWORKS

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(manuscript received 17 Apr 81) pp 9-10

[Article by Leonid Konstantinovich Golyshev, candidate of technical sciences, and Mikhail Timofeyevich Matveyev, candidate of economic sciences, Main Scientific Research Institute of Computer Centers of the Ukrainian SSR Gosplan, Kiev; Andrey Ivanovich Nikitin, doctor of technical sciences, and Anatoliy Aleksandrovich Stogniy, doctor of physical and mathematical sciences, Cybernetics Institute of the Ukrainian SSR Academy of Sciences, Kiev]

[Text] The constantly developing economic, social and technical integration of society is advancing the problem of creating regional computer center networks, and in the future, a national network which gathers and processes information for accounting, planning and control of the national economy.

The creation of regional computer center networks is a complicated technical and organizational problem. It must be solved within the framework of the existing organizational and legal relations between groups of enterprises and organizations of different departments, the developed mechanism for financing capital construction and compensation for operating expenses. The requirements on the construction of networks on the basis of series-produced data transmission equipment and computers and also the restrictions on using existing and constructing new communications channels are significant.

At this time several versions of computer network architecture have been proposed and implemented [1, 2].

When selecting the architecture for the regional network it is necessary to begin with the developed information flow structure within the framework of the interaction of the administrative agencies of the national economy, in whose interests the data gathering and processing systems are created.

The characteristics of each regional computer center network must satisfy the requirements of realizing a defined operating technology of departmental computer centers included in the network.

Regional computer center networks must be created on the basis of introducing standard design solutions which must be developed and improved in an actual

experimental network. Regional computer center networks are being developed by gradual association of departmental computer centers.

The presently produced hardware of the unified system of computers and the developed software permit the creation of computer center networks that satisfy the above-enumerated requirements. For creation of a regional computer center network of an industrial nature it is necessary to perform the following set of operations:

a. experimental operations including the investigation of information flows in the future network, the potential technology for solving problems in the network and also the choice of communications media and communications equipment;

b. the design of the equipment for the network junctions (computer centers), the data transmission subsystems, the set of functional problems, software and information systems;

c. capital construction of communications lines and completion of equipment of the computer center with data transmission means and other equipment specific to operation of the network;

d. checkout and experimental operation of the hardware and software of the network under all conditions of solving functional problems.

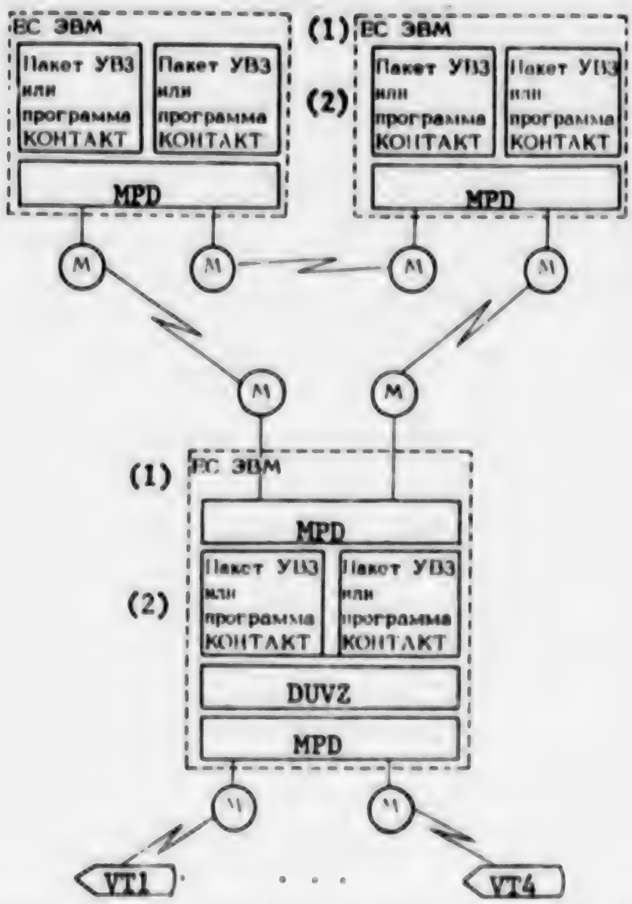
In accordance with the enumerated requirements, an experimental three-junction computer center network of the Ukrainian SSR Gosplan, the Ukrainian SSR Gossnab and the Central Statistical Administration of the Ukrainian SSR has been created on the basis of the equipment of the unified computer system, the architecture of which is indicated in the figure. The YeS1040, YeS1033 and YeS1022 computers are used at the network junctions. The data transmission equipment of each junction includes the YeS8503 multiplexor with synchronous adapter SA-2 (MPD in the figure) and the YeS8101 modem (M in the figure). Special lines with carrying capacity to 48,000 baud are used as the communications lines. Four video terminals (VT1 to VT4 in the figure) are connected to one computer. In addition, the AP-70 subscriber stations and call units are also included in the network hardware.

The computers at the junctions operate in the medium of the operating system of the unified system version 6.1. The following functions are implemented in the network: remote input and execution of assignments, sending information files, exchange of messages between operators at the junctions.

The network software is organized in such a way that between two interacting computers at any given point in time one machine plays the role of the central computer, and the other, the peripheral computer. If the operators wish, the roles of the computers can be switched. The central computer is the one in which a remote assignment input (UVZ) packet is activated at the given time. At the same time the KONTAKT program has been activated in the peripheral computer. This program supports the protocol of remote assignment input for the UVZ packet which is operating on the central computer as the systems problem similar to systems input and output problems.

The UVZ packet uses the basic telecommunications access method of the operating system of the unified system (OS YeS) to support communications with peripheral computers.

The UVZ packet provides for reception of the assignment sent over the communications channels from the peripheral computer and input of it to the input flow of the OS YeS. After completion of the assignment the UVZ packet returns the results of executing the assignment to the peripheral computer either directly or on command (delayed output). The central computer can print out the results or write them on magnetic tape.



Block diagram of a three-junction computer center network.

Key:
1. Unified computer system
2. UVZ packet or KONTAKT program

The received information can be represented in DKOI code ("transparent mode") and in KOI-7 code.

The operator of the central computer is presented the possibility of interfacing with the operators of remote computers and monitoring the state of the users, assignments and equipment by means of a console.

The KONTAKT program supports constant communications between the peripheral computer and the central computer and permits the following manipulations:

a. logical connection to the network or disconnection of the peripheral computer from the network;

b. transmission of instructions and messages from the peripheral computers to the central computer and reception of them;

c. transmission of assignments to the central computer;

d. output of results of assignments performed on the central computer;

e. transmission of data files on magnetic tape to the central computer with subsequent encoding of them on the central computer for performance of a remote assignment. The file can have up to 1M bytes.

Fast transmission of information files between a pair of computers with subsequent copying of them on magnetic tape by the receiving computer is also realized by the universal KOPIYA [COPY] program which is activated in the two computers. No restrictions have been established on the size of the transmitted file.

The described architecture of a three-junction network can be implemented for creating regional computer center networks that satisfy the above-enumerated requirements. The number of network junctions can be increased with corresponding regeneration of the UVZ packet and KONTAKT program. Further development of the network software is connected with organization of a distributed data base and addition of new computer centers and also subscriber stations.

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SOFTWARE

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BASIC SOFTWARE FOR EPP A5433 GRAPHICAL DISPLAY

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(manuscript received 27 May 81) pp 84-87

[Article by Vadim Ivanovich Govor, junior scientific coworker, IAPU, Far-Eastern Scientific Center of the USSR Academy of Sciences, Vladivostok]

[Text] At this time it is generally accepted that the machine graphics software must be constructed on the principles of independence of the type of computer and terminal equipment used, which is necessary in order to increase the mobility of the software and it is promoting more widespread use of it.

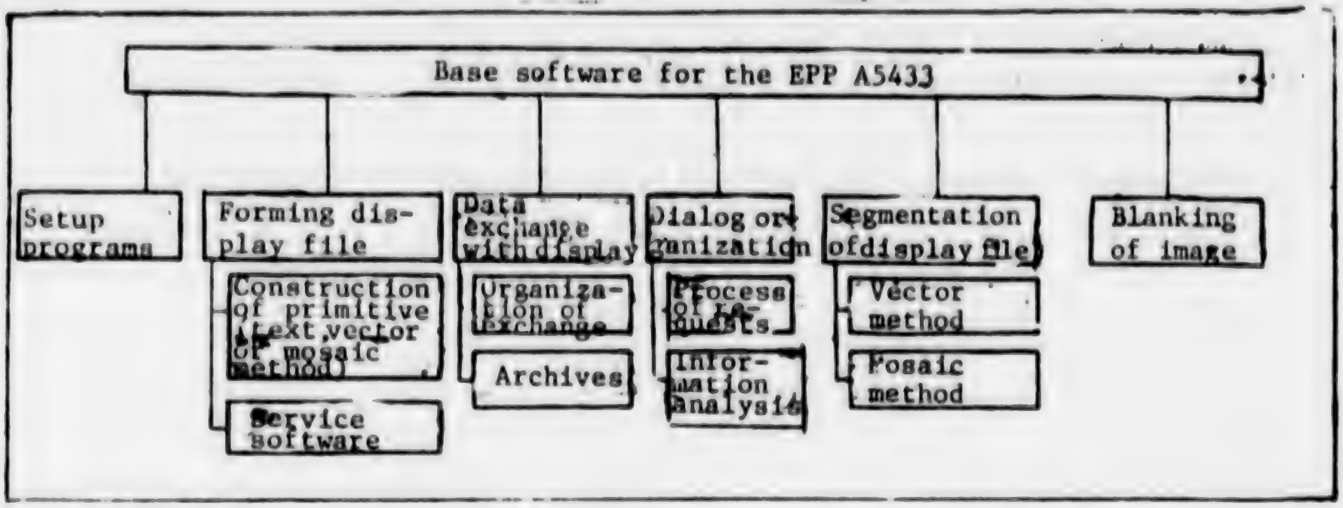
Independence of the types of peripheral equipment can be achieved when constructing multilevel software. In this case, the upper, universal part contains programs that implement the basic set of capabilities and do not depend on the specific graphics terminal. Communication with the graphics units is left up to the first level of software, the program modules of which consider the specific nature of the defined graphics unit.

Independence of the software with respect to the type of computer is achieved if the greater part of it is written in high-level algorithmic languages. In this case the operation of the software is possible after minimum processing on any computer having translators from these languages.

The multiterminal interactive graphics system DISGRAF developed at the Institute of Automation and Control Processes of the Far-Eastern Scientific Center of the USSR Academy of Sciences for operation in the operating system of the unified system has been constructed on such principles [1]. At the present time the terminal set of the system includes the graphic displays YeS7064 and EPP A5433 and also the plotter YeS7054.

This article contains a description of a package of graphical programs for the graphical display EPP A5433 developed within the framework of the DISGRAF graphical system and entering into the system as a program module of lower level [2]. The necessity for this development was dictated by the absence of such software for this display.

The program package realizes a functionally complete set of operations with respect to the formation and editing of the display file, organization of the graphical information input-output, maintenance of the graphical dialog conditions. In



Structure of the base software for the EPP A5433 graphical display.

addition, the package grants the user service capabilities with respect to formation of complex images, the organization of work with the graphical display archive. The structure and functional capabilities of the package permits its use as an independent graphical software when working with the EPP A5433 display.

Program Package Structure

Specific hardware capabilities of the EPP A5433 graphical display had significant influence on the choice of the structure of the executed software. These capabilities include, first of all, the presence of three essentially different methods of forming the image: vector, text and mosaic. Since for each of the methods the information word formats are different, the EPP A5433 can be considered in certain cases as a set of three different information display units. In addition, for the vector and mosaic methods, provision is made for the possibility of obtaining two-layered images.

The formation of an image on each layer is accomplished independently, after which the representation of each layer separately or superposition of the images of the two layers is possible. With the text method of forming the image, the operation can be performed with two alternately depicted pages of text information. The broad capabilities of autonomous editing of the image on the screen by the display keyboard impose their requirements on the software.

In the package structure a number of lower level functions have been isolated with respect to supporting the communications between the graphical display and the computer. These functions realize a set of macroinstructions of the graphical method of accessing the operating system of the unified system adopted specially for work with the EPP A5433 display. The execution of the operations of formation and editing of the display file, segmentation and blanking of the image and organization of the graphical dialog conditions are left up to the upper level programs. The execution of each of these functions in the package corresponds to a program module. Some of the modules are divided into program modules which arises from the presence of different methods of forming the image (figure).

Purpose and Operation of Program Modules

The group of setup programs is designed to determine the operating conditions of the package and the display. The programs of this group are used to select the conditions and method of forming the image, and a layer or page is defined. The blanking regions are requested.

The program module for shaping the image generates a display file in the form of attributes for the display processor and data in the on-line memory of the computer. Later the formed display file is transmitted by means of input-output programs to the buffer memory of the display for execution. The programs for compiling the display file are broken down into two groups: programs for constructing the set of graphical primitives and a group of service programs for constructing complex images.

The following set of primitives is selected for the vector method of shaping the image in the package:

setting of a ray;

point;

vector of arbitrary direction;

vector of one of eight fixed (every 45°) directions;

a line of alphanumerical symbols or special hardware-generated mnemonic symbols.

The necessity for including two primitives for constructing a vector arose from the fact that the EPP A5433 display has hardware capabilities for constructing vectors of only eight fixed directions. Therefore a vector of arbitrary direction is represented in the general case by a broken line.

For the mosaic and text methods of formation an image element is a row of alphanumeric symbols or mnemonic symbols.

The group of service programs is a set of programs for constructing standard images frequently used by the programmer. This group is constantly expanded as a result of including new programs created for specific applications.

The input-output program module is designed to organize two-way exchange of information between the on-line memory of the computer and the buffer memory of the display. The display file formed by the programmer is transmitted from the on-line memory of the computer; the display file altered during editing and dialog information from the display operator are transmitted from the buffer memory of the display. The input-output programs also include programs for limiting operation with the image archive created by the user. The images are stored in the form of fragments of a segmented display file equipped with additional service information. Complete reproduction of the image from the archive and subsequent work with it are possible.

In order to provide for the possibility of dynamic image alteration, the solution of problems of indicating and recognizing fragments of an image in a package a programmable display file segmentation unit has been developed. This hardware permits combination of individual graphical elements into named segments of the image and then work with them as with single indivisible blocks, eliminating them altogether, converting to the on or off state, performing an analysis to obtain graphical characteristics. The construction of complex structures of segments with deep embeddedness, limited only by the total number of segments is possible.

Speaking of segmentation of the display file, it is necessary to note a significant difference between the vector method of following the image on the one hand and the mosaic and text methods, on the other, in the method of depicting the contents of the display buffer on the display screen. This difference is connected with the fact that for the mosaic and text methods of forming the image each byte of the buffer memory of the display is uniquely related to a symbol location on a screen.

Accordingly, two display file segmentation program units were developed: one for the vector method of forming the image and the other for the mosaic and text methods. Within the framework of the second segmentation unit, a list structure of the data was constructed [3] permitting realization of the required set of operations while working with a segmented display file.

On the basis of the list structure of the data, an image blanking unit was also constructed for the mosaic and text methods of formation. The unit permits display of any region with piecewise-linear boundary on the display screen as blank, inside or outside of which program formation of image elements is forbidden. The maximum number of blanks depends on their size and can reach 512.

The dialog mode of working with the graphical display EP A5433 is based on organizing and processing attention requests from the display in the computer and two-way information exchange between the buffer memory of the display and the on-line memory of the computer. The display hardware providing for the dialog mode includes a marker, alphanumeric and functional keyboards, autonomous editing and image shaping keyboard for each of the three available shaping methods.

The software providing for the dialog mode generates requests for attention from the display, it analyzes the graphical information introduced from the display to the computer and also transmits dialog information to the user program.

Work in the dialog mode is realized as follows. On arrival of a request for attention from the display at the computer, the execution of the user program is interrupted and control is transferred to the corresponding package program for processing this request. The user program is transmitted the number of the pressed key of the functional keyboard or the state of the entire keyboard. In addition, a file of additional information also transmitted to the user program is formed. This file contains values of the marker coordinates, the parameters of naming the image segment marked by the marker, and certain other information about the introduced image.

For identification of an individual segment of the image, the display operator can isolate it on the screen by increased brightness. After reading the image in the computer the graphical information analysis program permits the characteristics of

the isolated segment to be obtained. This possibility is convenient when the programmer is organizing the light buttons [4].

In addition to the graphical information input, input of text and numerical information from the display screen is also possible. A row of symbols read from the screen can be converted to a series of numbers of given format and transmitted to the user program.

Package Characteristics

The described base software for the EPP A5433 graphical display is executed on the M4030 computer in the operating system of the unified system and can also operate on the unified system of computers. It is proposed that the user work with the package through references from FORTRAN programs and an assembler.

At this time the package of programs for the EPP A5433 contains more than 40 programs written primarily on the assembler of the operating system of the unified system. The total volume of the package programs is about 7000 text cards.

The described software is in operation at the computer center of the IAPU Institute of the Far-Eastern Science Center of the USSR Academy of Sciences where applied problem oriented program packages are being developed on the basis of it.

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SOFTWARE AND SYSTEMS PROGRAMMING IN BELORUSSIA

Minsk PROMYSHLENNOST' BELORUSSII in Russian No 9, Sep 81 pp 6-11

[Article by G. Lopato, director of NIIEVM: "Charter Courses for Computers"]

[Excerpt] In Belorussia the software for the YeS EVM (Unified System of Computers) is basically being developed through the efforts of several institutes. The NIIEVM (Scientific Research Institute of Electronic Computers) is working on operating systems and compilers from general purpose programming languages, on multiple use systems, microprogramming, automated design etc. The Mathematical Institute of the AN BSSR (Belorussian Academy of Sciences) is developing programming packages for scientific applications, running the republic's library of algorithms and programs, has created a compiler from the ALGAMS language and is conducting work on data bases and on a multiple use system for the AN BSSR. The Engineering Cybernetics Insitute of the AN BSSR is developing a system of automated design in the area of machine building. In the Belorussian State University imeni V. I. Lenin, instructional systems for managing the educational process have been created and are being worked on. Certain work on YeS EVM software is being performed by the regional computer center of the TsSU (Central Statistical Administration), a branch of the VGPTI (All-Union State Design Technology of Control), and other organizations. The TSNIITU (Central Scientific Research Institute for the Organization and Technology of Control), should be mentioned separately, since it is creating a broad range of specific ASU's (Automated Systems of Control) for a number of sectors of the economy.

In 1976-77, a territorial administration CNPO (expansion unknown) "Algorithm" was established in Minsk to provide centralized technical maintenance of the YeS EVM computer, instruction for use is of its software and software maintenance.

Before going on to speak of specific developments, I will note that contemporary computer software is an inseparable part of the system, which determines the computer's mode of operation and the procedures which must be followed by all categories of users - programmers, operators, computer maintenance personnel and computer center administrative staff in their work with the computer.

The work of the NIIEVM on software is characterized by complexity and integration with hardware. Starting with computers in the "Minsk" series, a large part of our attention has been devoted to effectively interfacing hardware and software in order to obtain optimum capabilities for the system as a whole. These features of the computers and software created in our institute have facilitated their widespread adoption and use in the economy of our nation and abroad. In 1970 a group of workers in our institute was awarded the USSR State Prize and Lenin Komsomol Prize for the development of the "Minsk" series computers and software. In 1978, another group of institute workers was awarded a USSR State Prize for the development of the YeS EVM operating system and its implementation.

Today the systems software of the YeS EVM is a well balanced set of effective programming aids, widely used in many sectors of the economy. Its basis is the OS (Operating System) and DOS (Disk Operating System) operating systems which manage the functioning of all models of the YeS EMV in diverse modes of use and offer users a rich assortment of aids for automating the process of program preparation.

The implementation of the batch job processing mode is virtually completed. Such operating system capabilities as multiprogramming, remote submission of jobs and processing of data received from terminals are well-known and are being used effectively. The YeS EVM operating systems are continually evolving, being augmented by new components and providing users with new capabilities.

In the NIIEVM, six versions of the DOS operating system have been developed. For more than two years, this was the only operating system in the country and was used by all Unified System Computers. Even today it is widely utilized by Soviet and foreign users of newer and intermediate models of the YeS EVM. Work on the DOS operating system was completed with the release in 1977 of the DOS-2. DOS-2 contains almost 1.5 million commands.

Beginning in 1976, our institute has taken an active part in the development of the OS, an operating system more powerful than the DOS, which is intended for intermediate and older models of the YeS EVM. Several substantial collectives of programmers in various institutes of our nation and abroad are engaged in work on the OS. The NIIEVM's participation in the OS's development has involved the creation of systems of programming, time sharing and other components. This work has significantly expanded the YeS EVM's capabilities and has been widely used to solve various problems in many sectors of the economy.

What, in brief, is the nature of these developments? First of all, programming systems enable automated compilation and debugging of programs written in high level or assembly languages. Usually the programming system is made up of a source language, compiler, library of standard programs for the language and debugging aids for that system. In the basic software, the programming system takes up not less than 60% of the general programming resources.

Our institute has had much experience in the development of systems which have been widely applied in our nation. We will note several of those developed in recent years:

1. The conversational programming system (DISP) based on the PL/1 and BASIC languages for the OS operating system. It can simultaneously service up to 31 users who are hooked up to the computer through dial up or dedicated communication lines using YeS-7906, YeS-8570 (AP-60) or YeS-7920 terminals.

At the terminals, users working in conversational mode have the capability to perform all the operations necessary for solving problems: inputting, executing and debugging programs, modifying them and saving programs and data for repeated use. DISP contains numerous and powerful aids to bebugging programs written in the PL/1 and BASIC languages.

2. An optimizing compiler from FORTRAN. The inclusion of this compiler in the operating system, in place of the previous FORTRAN N, offers users new capabilities of the language, a more convenient specification of the compilations modes and optimizes program run time and memory space used.

3. A FORTRAN programming system for time sharing mode. This gives subscribers effective conversational devices for all stages of the solution of problems using a computer. With this goal, the system includes:

- a compiler for high speed translation, useful in debugging;

- a compiler from standard FORTRAN for obtaining high quality programs;

- a conversational debugger for performing debugging using the terms of FORTRAN.

4. In 1979, the development of an optimizing compiler form PL/1, which operates in OS, was completed.

In comparison to the previous one, this compiler makes it possible to cut run time by a factor of 2 or 3, while at the same time decreasing total program length. Moreover, several new capabilities of the system have been realized: precision of floating point data representation has been increased, new built-in functions have been introduced, means available for the creation, debugging and restarting of large program sets have been broadened. The compiler operates in both batch and time sharing modes.

5. Compilers from the KOBOL language. In 1976-77, two compilers from the Russian version of standardized KOBOL were developed: one for the DOS operating system, the other for OS. Previously in DOS and OS, there existed compilers only from the English version of standardized KOBOL. The use of its Russian version shortens the time required by users to master the language, decreases the number of errors made in coding and punching, simplifies debugging and improves program documentability.

The level of development of programming systems within the framework of work on the OS operating system grows constantly and this is natural, since the effective use of computers is impossible without high level programming languages and the corresponding compilers meeting a variety of needs of applied program developers:

- debugging compilers for easy and quick debugging;

- optimizing compilers capable of creating programs which are optimal with regard to execution time and memory space occupied;

- conversational compilers for step by step development, debugging and execution of programs.

The programming systems developed at the NIIEVM for the DOS and OS operating systems are a tool accessible to the average user for use in solving the problems he confronts.

One of the most important modifications of the OS operating system, developed by the NIIEVM in 1976-78 is the time sharing mode, which permits many (remote) subscribers to receive the whole set of computational services now available to the programmer at a computer center. Before the time sharing system was developed, the operating system could only operate in batch mode and today problems involving little hand preprocessing of data and long computation times are solved effectively in this mode. The batch mode of job processing, without a doubt, will continue to be used in the future. However, with the appearance of convenient terminals set up right at the programmer's work place, it has become possible to carry on a conversation with the machine on-line and at any time. The time sharing system allows numerous subscribers to manage programs and data, have access to common data, exchange information with an operator at the central computer console and, finally, makes it possible to create a program, compile and debug it in a conversational mode. The SRV (time sharing system) is the basis for the creation of ASU's (automated systems of control), information retrieval systems, systems of automated design and instruction and systems for gathering and processing information. Using it as a base, one can create multiple use systems for the solution of the most diverse problems.

In 1979 the time sharing system was released to be supplied to users. It was incorporated in the NIIEVM and also in more than 10 organizations in the country.

In 1980, development of a new version of the SRV for computers with virtual memory was completed. In this version, the operating system, which represents to the user a virtual memory of 16 million bytes for residence of programs and data, takes over the solution of all problems related to the calling up of programs and data in the real memory of the computer.

In total, the set of program devices developed by the NIIEVM during the 10th Five-Year Plan consists of 12 independent components which have been

tested through experimental use at computer center facilities and have been released to be supplied to users. In addition, each year approximately 620,000 commands and 4,000 pages of documentation are produced in our institute.

The average attained productivity of labor of 2,000 commands per person per year is appropriate to the contemporary level of programming. At the same time, it must be increased further through automation of the process of program development.

During the past 15 years, the productivity of the computer has grown by one or two orders of magnitude, while the productivity of the programmer's labor has remained essentially unchanged and consists of from 1400 to 2200 commands per person per year, falling to 300-600 commands for real time systems.

Analysis of a great deal of factual material indicates that program production contains on the average 10-30 errors for each 1000 commands. This complicates matters, since the identification of errors in a program adds an additional 30-50 percent to the total expenditure of labor. The need to correct and modify errors (during debugging) increases the size of programs by 30-40 percent.

There exist two generally accepted ways to increase the productivity of programmers' labor: the creation of good programming languages and automation of a whole set of tasks - from the formulation of the technical problem to system delivery and maintenance.

The set of tools for program development automates the whole process, including the formulation of problems, the functional and structural description of components, the writing of programs and tests, debugging, testing and submission of the programs, the creation of documentation and its preparation for print etc. Naturally, this set of tools must contain effective means for debugging programs, evaluating the programs produced and must support the organizational aspects of control of program development, i.e., the construction of flow-charts, fixation of the projected solutions, release of information about progress of work etc.

This set of tools for automation of software development consists of a computer with large rack-up memory capacity on disks hooked up to alphanumeric display units operating in conversational mode.

The adoption of modern technology of programming and automation of documentation production makes it possible to:

- increase the productivity of labor of systems programmers two or threefold;

- raise the quality of the programs produced;

- diminish substantially the physical amount of documentation, by transferring it to microfiche and microfilm, while at the same time increasing its quality and reliability.

3. Problems in Software Development

As was noted above, in Belorussia we have established a good inventory of on-going work involving all the major trends in systems programming. There is a corresponding technological base which uses the newer and intermediate models of the YeS EVM. There are approximately 200 computer centers in operation, in which several thousand programmers work. Taking account of the general trends in software development and the state of affairs in our republic, one can name several of the most pressing problems whose solution would make it possible to advance systems programming considerably.

The first and foremost issue to which attention must be directed involves multiple use systems (SKP). These make it possible, on one hand, to provide subscribers with on-line access to the system as a whole and, on the other hand, to achieve optimal utilization of equipment. SKP's are general purpose in nature, they easily adapt to the needs of specific organizations. The center of gravity in such adaptations lies in the operating system.

Problem solving in multiple use systems is most effective within the framework of a new operating system using virtual machines (SVM), which was created by the NIIEVM. It initiates a new stage in the development of YeS EVM operating systems. Retaining the entire arsenal of attainments of the DOS and OS, the SVM develops the ideas, methods and capacities found in them in accordance with state-of-the-art technological devices, experience with software creation acquired in the practical world and also new ideas in this area.

The central concept of the SVM is the concept of the virtual machine, generalizing to the level of the whole computer the principle of virtualization of individual machine units. Just as virtualization of primary memory gives the illusion of the existence of a memory with virtually unlimited capacity, the virtualization of the computer creates the illusion that there are many computers at the disposal of the user. The SVM operating system makes it possible to have several operating systems, including the DOS, OS and SVM, operating at the same time on a single machine.

The virtual machine system makes operation in time sharing mode and the creation of multiprocessor and multimachine complexes possible and provides users with effective aids for program development and debugging.

Important advantages of the SVM also include:

- the possibility of cooperation among simultaneously operating virtual machines for the solution of common problems;

- strong protection of a user's programs and data against unauthorized access;

- greater reliability in comparison with the DOS and OS operating systems;

- fast restoration of working capacity after appearance of hardware and software faults.

Using the SVM as a basis, it is possible to create effective and highly reliable multiple use systems, ASU's for various purposes, large data banks, information retrieval systems and automated design systems. The SVM is intended to operate on the "Ryad-2" and "Ryad-3" computers.

The next problem involves programming languages and compilers. Research should be performed on the classes of problems solvable by computers, in order to determine the requirements for appropriate programming languages. It would appear to be possible to identify the following large classes of problems:

- systems programming;

- scientific and technical problems;

- automated control systems;

- systems for automated design;

- management of large data banks;

- management of the instructional process in VUZ's.

The most effective languages for each class of problem must be selected and a complex program to develop the appropriate compilers, debugging, optimizing conversational etc. must be implemented.

In the technology of programming, emphasis must be placed on the creation of several sets of tools intended for the complex automation of software development, including the production of documentation and software maintenance. Stable improvement in the productivity of programmers' labor is possible only with the help of such tool sets.

Increase in the reliability of software is one of the most important tasks involved in ensuring the viability of information processing systems and in decreasing the probability that a system will function incorrectly. In the design stage, primary attention is given to the correct operation of the system on "good" or input data. After successful testing, the system (as a tule, still containing hidden errors) is released for use, in the process of which it is revealed that, among the actual external data, there are some which had not been planned for. All these unforeseen external data, incompatible with the purpose of the system most often lead to transient errors and faults in operation, since they evoke a chain reaction consisting of the formation of incorrect intermediate results. In the final analysis,

the operation of the system may turn out to be unpredictable. The source of such unspecific data may be:

- the actual processes which the system must control;

- a person taking part in the work;

- hardware and undebugged programs;

- other systems, interfaced with the given one and giving it information (calling it), a multiple use system.

In any case, it is necessary to place a filter on the path of the input data to forestall the penetration of false (incorrect) values into the system. Moreover, such filters can be rigged to react in specified ways to the various incorrect values, for example:

- by replacing them with standard values;

- by ignoring the input record;

- by searching for the "nearest" correct value;

- by transferring control to a special user's program.

Filters take on special significance in relation to the development of highly reliable systems, in which the price paid for an undetected error may turn out to be catastrophically high.

The complexification of the YeS and SM (International System of Small Computers) Computers. In recent years the spheres of application of the mini-computer has broadened intensively. These machines, foremost among them the SM EVM, offer the most effective solutions to problems such as the preparation of data for input into a powerful computer, the preliminary processing of experimental results, local control of a group of instruments or machine tools, the execution and processing of complex measurements made on test beds and production lines, the output of documentation etc.

As a rule, such complexes based on the SM EVM perform only a small portion of the work and are hooked up to a powerful computer for performance of large scale calculations and interaction with a large data bank.

Given the conditions existing in Belorussia, it is probably expedient to expand work on the complexification of the YeS EVM and SM EVM into the development of common systems software and a series of standard complexes for multiple use systems, ASU's and systems for automated design and management of instruction.

Microprogramming is one of the most promising trends in the development of computer technology and systems software. If, heretofore, the user perceived the computer as an unalterable unit whose functions were determined once and

for all time, he has now obtained the means to alter the "commands" of the machine. In accordance with the class of tasks involved, the user can "program" the machine to obtain optimum operating characteristics: speed of computation, convenience of a new system of commands, or shortening of the time required by compilation or interpretation.

Microprogramming has posed a series of interesting problems for systems programming, the solution of which will significantly increase the efficiency of this new powerful device. We will cite two of these problems - the optimization of microprograms and automation of the processes of creating and debugging them. There already exist preliminary approaches to the solution of these problems. However, their full solution will require a substantial degree of concentration and coordination of the efforts of many collectives.

In recent years, there have been important changes and increases in the requirements for training cadres, particularly of young specialists in the field of systems programming. Conversational languages, high and ultra-high level languages, work in time sharing mode, the technology of programming, microprogramming, computer nets - this is far from a complete list of the issues they must deal with in their daily work.

Virtually the only sources for replenishing the cadres in our republic are the Belorussian State University imeni V. I. Lenin and the Minsk Radiotechnical Institute. Clearly, it is necessary to broaden the list of majors in programming, increase the number of students accepted and most important, to equip the BGU and MRTI with multiple use systems based on the YeS-1060 and YeS-1035 computers.

The problem of concentration of effort and coordination of work in our republic is the most urgent of all the problems enumerated. Unfortunately, much of our programming strength is scattered among many organizations. In addition, coordination of work and concentration of effort and resources on the most important directions are virtually nonexistent. The complex plan of work for the next few years could focus on uniting the efforts of specialists and financial and material resources.

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AUTOMATED DESIGN WORK IN BELORUSSIA

Minsk SOVETSKAYA BELORUSSIYA in Russian 9 Jan 82 p 1

[Article by V. Romashko: "'Konduktor' Comes to the Rescue"]

[Excerpts] The Belorussian Academy of Sciences Institute of Technical Cybernetics is the head organization in our country for the application of mathematical methods and computer equipment for automated design work.

The initial stage in this kind of automation is linked with the name of corresponding member of the Belorussian Academy of Sciences G.K. Goranskiy. As long ago as the early sixties he developed the methodological bases for describing machine building objects and design processes and defined ways for deriving algorithms for solving a number of important design problems.

A number of automated design systems have been developed on the basis of these methodological developments. Among the first in the republic to evaluate the significance of this innovatory decision was the leadership of the Minsk "Gorizont" Production Association, which became a base enterprise for the Institute of Technical Cybernetics to introduce automated design. The first fruit was the "Konduktor-1" system for designing drilling gears, which was followed by the introduction of a computer system for designing dies. During 6 years of cooperation with the Institute for Technical Cybernetics "Gorizont" has made a savings of more than R100,000 from the introduction of automated design.

....Here we are in the chief technician's design bureau for automated preparation of the production section at the "Gorizont" Production Association. Here two automated drawing systems, the "Itekan-2M" and the "Konduktor-3" are operating at full capacity.

"The 'Konduktor-3' system replaces the designer, technician, rate setter and, partly, the economist," chief of the laboratory for automated design work for technological equipment at the Belrossuian Academy of Sciences Institute of Technical Cybernetics, State Prize laureate Aleksandr Gavrilovich Rakovich tells us. "This comprehensive system was introduced at the 'Gorizont' last year. It not only reduces design time by a factor of 6 to 8 and design costs by a factor of 4 to 5, but also significantly improves design quality. This innovation frees engineers for other creative work. Moreover, the labor of specialists servicing this equipment become more interesting and filled with content."

The laboratory led by A.G. Rakovich is the only one of its kind in our country. It was set up 13 years ago. Highly qualified engineers and machine tool builders and programmers work here. Their scientific work produced a saving of about R1.5 million in the national economy during the last five-year plan.

Last year, 1981, for example, a computerized design system for lathe attachments was handed over to the "BelavtoMAZ." Using this equipment, in the special design bureau of the Minsk plant for automated lines they are now working on a design system for transfer machine tools. Similar developments are being introduced at the Minsk association imeni V.I. Lenin and the computer association, and at the electro-mechanical and other plants in Brest.

9642
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PROBLEMS IN OFFICE AUTOMATION

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 29 Jan 82 p 2

[Article by Ye. Lesnov, deputy chief engineer at the "NOTsnab" Production-Technical Association]

[Text] A protracted difficulty occurred recently in the computer room of one of Riga's enterprises. Essential technical data were in the computer store, or more accurately, in an unadapted two-drawer cabinet where everything lay in a heap. At some other time the store rooms had turned down an offer to put this material on punchcards, and now the "thinking" machine refused to solve the problem. These kinds of difficulties can, in the end, be expensive.

The situation with storage and systematization of documentation and business correspondence is sometimes even more unfortunate at those enterprises and establishments that are not equipped with automated control systems. And everything turns on just one thing: if there is a lack of accounting and business machinery and an "information explosion," we tackle things in an antiquated way--with our bare hands.

In essence, there is only one organization in the country that develops--plans and manufactures--specialized office equipment for working places in the administrtaive apparatus and for engineering personnel. This is our "NOTsnab" production-technical association located in Latvia under the USSR Gossnab. We produce office equipment for computer centers--sets of equipment made up of up to 80 kinds of articles. The products list of equipment for working places for other specialists is even larger--about 300 items.

The almost 20 kinds of desks for the administrative apparatus produced at the association are distinguished by their sets of mechanical attachments varying depending on the production profile of the worker: the design of the drawers altered using telescopic guides, the trays for documents, offical appurtenances, secretarial tools.... But we make all these things "for ourselves," that is, for the internal needs of Gossnab, whose administrative apparatus we serve. Hundreds of enterprises, scientific research institutes, planning organizations, VUZ's, and planning and other establishments, and virtually all the all-union and republic ministries and administrations are trying to set up contracts with us. In this, many of them make use of the streamlined formula of "as mutual

aid." We'll give you anything, they say, just build us an up-to-fate business office. But what we can make, as they say, on the side, is only a drop in the ocean when its comes to the total demand.

We think that the Latvian experience could be a realistic way out of this situation. In Riga, at the small "Kommunal'nik" plant belong to the republic Ministry of Consumer Services a building was recently constructed on the initiative of (and with funds from!) the Latvian SSR Council of Ministers where the production of office equipment for all kinds of administrative services has been set up. By the end of the current five-year plan this new intersector subdivision will have reached the same kind of output volume as our association. We are providing it with the necessary engineering documentation and are helping with consultation methods, and to begin with we are supplying technical equipment and the most complex sets of parts. The matter has been taken up in real earnest by the Latvian Gosplan interdepartmental council. And, as they say, the wheels have really started to turn.

The manufacture of so-called office equipment does not require any kind of unique machine-tool inventory or special materials. Production of the necessary articles can be set up at any machine-building plant with universal machine tools, using cheap metal, plastics, lumber--even production waste.

We are prepared to furnish our own designs, which are as good as the best foreign models, to all parts of the country. The articles designed by the association have won many medals of the USSR Exhibiton of National Economic Achievements and at international trade and industrial fairs. We handle both complete standard sets and custom orders. But, alas! we can name only a few industrial enterprises in the country (primarily those belonging to the Ministry of Tractor and Agricultural Machine Building) where our recommendations are used. Meanwhile, hundreds of thousands of people engaged in the management sphere, even with modern automated control systems and automated enterprise management systems, are working with antiquated methods, failing to achieve the necessary labor productivity and wasting the most expensive thing in modern management--time. I think that the question of providing specialists and administrators with office equipment should rivet the attention not only of the planning organs and sector headquarters but also the public at large.

9642
CSO: 1863/87

ELECTRONIC AIDS

Tallinn SOVETSKAYA ESTONIYA in Russian 24 Jan 82 p 3

[Article by A. Zhudinov]

[Text] It is intended to introduce a number of innovations this year at the Tallinn taxicab center. For example, there are plans to completely automate the dispatcher service. This cannot be done without the aid of the latest computers. Every day the dispatchers at the taxicab center deal with an average of 2,000 calls.

Specialists from the republic computer center for automotive transport and the Estonian branch of the Riga "Impul's" Test Plant have now installed an SM-4 minicomputer and six "Iskra-554" electronic accounts machines in the machine room of the administrative buildings at the Tallinn taxicab center.

Minicomputers developed at the Kiev "Elektronmash" Production Association are considerably facilitating the work of the dispatchers and making it possible to improve client services.

The "Iskra-554" electronic machines are helping to generate bookkeeping documentation and routing lists and to improve on-line operations and the accuracy of secretarial work. The electronics also help in rational utilization of vehicles and in cutting down on the time taken to complete assignments. But this is only the beginning.

In 1983 it is intended to introduce several more electronic devices here.

9642
CSO: 1863/87

SOLVING DATA INFORMATION TASKS IN INTERACTIVE MODE

Moscow NA STROYKAKH ROSSII in Russian No 11, Nov 81 pp 29-30

[Article by Chief Engineer of PTB (Safety Engineering Regulations) for Systems Administration S. Makeyev and Sector Chief of Systems Programming S. Kudel'kin]

[Text] Modern computers provide broad possibilities for receiving data with minimal superfluousness and with maximum reliability at the expense of a rapid search and preliminary processing of it. However, today the traditional package processing of tasks is not answering the demands of operatively providing data to the user. At the same time, the possibilities of the technical facilities are realized as totally inadequate. Such an unsatisfactory situation has caused, in particular, the necessity of including data processing (request, processing, data output) of the intermediate links (programmers, operators and so forth) in the technological chain. This reduces operability and creates additional conditions for the appearance of errors (logical and mechanical) in the chain of data exchange between the computer and the user.

The availability of alpha-numeric facilities for data presentation (videoterminal complex ES-7906) and of an existing mathematical support computer for it allows for the development of programmed systems that perform request-response (dialogue) modes of operation of the user with a computer which is devoid of the higher enumerated deficiencies of the package mode. Such systems provide the user in simple and visual form the possibility of composing a data processing request on the display screen and receiving the result practically at any moment of time in a form convenient for him (for example, the request can be an output requirement for a certain statistical form or operational data).

The configuration of the dialogue system is as follows. A short control program (UP) constantly arranging in the operational memory and performing: exchange operations with the display complex indicators on the basis of the graphical method of access; dispatch of requests being received from several displays taking their priorities into account; dynamic loading of the processing programs (OP) in the form of sub-tasks of the operational system; page output to the screen of data received as a result of performing

the processing programs corresponding to the request. Also comprising the system is an arbitrary number of processing programs which are arranged in the library of loading modules and summoned from there as needed.

Thus the processing of a dialogue system on the basis of a control program results in the writing of some number of processing programs by means of using only the standard facilities of PL/1. Modularity of the system produced permits it to correct easily and rapidly through simple substitution of any number of the processing programs and the dynamic load of the processing programs to use efficiently the operational memory.

Execution of the request can be inserted in one or several steps. Each step begins with the control program input of initial data for a given step and the output of the next processing module. Assigning the necessary meanings of the exchange area control fields, the processing program indicates to the control program the operations which are necessary to accomplish upon its completion; and also the name of the processing program which will be summoned next. The next processing program can be summoned immediately upon completion of the current one. This allows the processing program to be broken down into an arbitrary number of successively executed modules that can turn out to be essential when there are limitations on the operational memory.

All processing modules, executing one or another request, can exchange data through the retaining area provided by the control program. The dialogue step terminates with the output of the processing result to the display screen by the control program. If the output information exceeds the size of the screen, then it is broken up into pages of 960 bits and recorded in the data index-sequencing set intended for this purpose, from where the control program brings its page output to the screen depending upon the operator's requirements. The output can be made by page number or in succession.

On the basis of the control program, the following data-information tasks have been worked out and are presently functioning: automated control system for executing tasks (ASKIZ); analysis of executing a construction-assembly operations plan for particularly important objectives (OVO); forming operational information concerning the activities of contracting organizations in the main construction administration.

Let's examine ASKIZ, as the simplest of all the enumerated tasks, in more detail. After starting, the control program delivers the information to the screens of all active terminals: "Terminal is ready. Indicate request code" and goes over to the holding condition. The operator indicates the code "ASKIZ" and presses the "Input" key. The control program conducts a search of the request table and when the indicated code is available in it, it summons the first processing program for the "ASKIZ" task by name found in the table. This processing program forms a table of function codes which also is brought to the screen (Table 1).

Table 1

Function: Executor Code: Controller Code:

Table of Permissible Function Codes

Code	Expansion
AZ	Execution of Tasks
VD	All Documents Taken Under Control
VS	Tasks Executed in the Period
VO	Tasks Executed With Delay
PV	Tasks, Execution of Which is Forthcoming
NI	Non-Executed Tasks From the Last Period
SP	Code Reference Book for Controllers and Executors
KR	End of Operations

Having checked it, the operator sets the code of the desired function and, if required, the executor code and (or) the controller code and presses the "Input" key. The control program inputs the information and summons the processing program which executes the tasked function, having sent the executor and controller codes to it as a factor. Usually the operator begins the operation by checking the reference book. To do this, he sets the 'SP' function—Code Reference Book for Controllers and Executors; and since the size of the reference book exceeds the dimensions of the screen, then as a result of executing the 'SP' function the first page of the reference book will be presented on the screen (Table 2). In order to receive a page with an arbitrary number, the operator must indicate the required number. In order to receive the next page in order, it is sufficient to press the "Input" key.

Table 2

Page: 001 Code Reference Book of Officials

Code	Last Name, First Name, Patronymic	Position
01	Ivanov, I. I.	Manager of Orgtekhstroy Trust
02	Petrov, P. P.	Technical Department Head

Having determined the code of the desired official from the reference book, the operator by special command again summons the code function table to the screen and, having set the function code and the code of the official, receives the desired information. For example, the operator wishes to receive information concerning the progress of tasks performed by Petrov and received by him from Ivanov. According to Table 1 [stet], one can see that Petrov's code is 02. Setting Code 02 in the "Executor Code" field, Code 01 in the "Controller Code" field, and Code AZ in the "Function" field, the operator will receive the following information on the screen (Table 3).

Table 3

Executor Code: 02   Controller Code: 01

Analysis of Tasks Executed on 1 April 1980

Controller: Ivanov, I. I., Manager of Orgtekhstroy Trust

Executor: Petrov, P. P., Technical Department Head

Total Tasks: 48

Executed: 32   Number of Them Executed in the Period: 17

Not Executed: 16   Number of Them From the Last Period: 2

Let's suppose that having checked the information received, the user decided to display on the screen the documents containing the tasks received by the executor Petrov from the controller Ivanov and not performed by him. As in the previous case, the operator by special command summons the code function table to the screen and sets the 'PV' function. As a result the first document from the mass, which satisfies the tasked condition, appears on the screen (Table 4). Receipt on the screen of the next page of information, which contains another document from the tasked mass, is similar to the one described earlier. Just like that the operator can request execution of all the other functions.

Table 4

Page: 001

Order of the Orgtekhstroy Trust from 1 April 1979 concerning the implementation of an automated control system for executing tasks. Technical Department of Orgtekhstroy Trust is to review the problem of financing operations connected with the implementation and operation of an automated control system for executing tasks

Controller: Ivanov, I. I., manager of Orgtekhstroy Trust

Executor: Petrov, P. P., technical department head

Directed Period of Execution: 1 June 79.

Actual Period of Execution: 1 June 79.

By special command the operator can cease processing the request at any step of the dialogue and return to the initial information "Terminal is ready. Indicate request code". Following this the operator can continue the operation with another task, and for this it is sufficient for him to indicate its name in the "Request Code" field (for example, in order to receive the control information on construction of particularly important objectives, it is necessary to indicate the code "OVO").

Management of the program is extremely simple and obvious and does not require the user to have special training except for a knowledge of several simple commands. The reaction time of the system depends on the size of the data base in which the search is conducted, on the number of users working simultaneously with the program (up to four active displays) and the general load of the computer (the operation is conducted in a multiprogrammed mode). The reaction time did not exceed 10-15 seconds for the version of the program described here functioning with the ES-1022 computer.

9889
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UDC 621.391:658.012.011.56:658.286

PROBLEM OF DATA GATHERING, TRANSMISSION AND PREPROCESSING IN AUTOMATED TRANSPORT CONTROL SYSTEM

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
(manuscript received 15 Feb 79, after revision 18 Jun 81)
pp 33-36

[Article by Oleg Anatol'yevich Vokhomskiy, engineer, UEMIIT, Sverdlovsk]

[Text] One of the urgent problems of creation of automated transport process control systems is the development of automated means of gathering, transmitting and preliminary processing of data on the transport rolling stock known as an automatic read system for reading information from moving objects. The problems of substantiation and the necessity for developing such a system have been widely discussed [1].

The automatic data read subsystems known at the present time do not satisfy the modern requirements on ensuring efficiency and quality (in particular, ensuring reliability no less than 10^{-6} to 10^{-7} for a read decimal bit), in connection with which further search for new types of recognition information transmission systems and new principles for constructing them is needed.

In the proposed article a study is made of one of the approaches to the synthesis of automated data read systems based on combining the methods of the theory of statistical solutions and information theory [2, 3].

In structural respects the most economical version of constructing this type of system is achieved on separation of the functions of answering and identification of mobile units. In this approach the processing unit is installed at the computer center, and a direct high-speed data transmission system is organized between it and the answering element in the field. The advantages of this solution are as follows:

a. data input to the computer is simplified;

b. the amount of hardware required to transmit the data from the base element to the computer center is decreased;

c. it becomes possible to service a group of answering elements by one processing unit;

d. the servicing of the system is simplified and facilitated;

e. rigid climatic requirements are not imposed on the processing unit;

f. the cost indices are lower.

It is possible to achieve high noise immunity with given transmitter power by selecting the optimal form of sounding and response signals and also optimal methods of processing them [4].

As applied to the problems of reading information from mobile units and direct transmission of it over the communications channels, signals with linear frequency modulation (LFM signals) characterized by a large product of the duration T_s times the spectral width Δf_s are of interest [5]. The LFM signal is a series component (complex) signal, and it is distinguished by large information redundancy [6]. In systems with complex signals, the redundancy is used to assign a special structure to the output signals of the code sensor permitting us to obtain a set of signals with required correlation properties. The static characteristics of such signals are close to the white-noise characteristics, in connection with which the possibility appears for effective detection and recognition of useful signals in the presence of interference. As a result of the information redundancy of the code sensor signals, high noise immunity of transmission of the coded information from the answering elements to the processing units is ensured, and the coupling between them is possible using radio or cable lines. There is no necessity for data transmission hardware.

The standard method for processing complex signals is the correlation method for which joint processing of the component signal elements is characteristic. Here compression of a quite long signal to a short pulse occurs which ensures high resolution, noiseproofness and reliability simultaneously. For implementation of this method correlators and matched filters are used which permit us to obtain significant gain in noise immunity under the effect of various interference. When processing complex signals, under the effect of the noise interference this gain will be B_s times and under the effect of pulse interference it will be B_s^2 times, where B_s is the signal base [7].

Shaping of Complex Signals. Figure 1 shows a diagram of the developed version of the device for shaping the sounding and response signals with LFM carrier [8].

The frequency generator 1 generates sounding pulses with LFM carrier which are fed to the transmitting antenna 2 and are emitted in the direction of the moving object 3. A code pickup 4 with receiving and transmitting antenna is installed on the moving object. The sensor is made from individual oscillatory circuits based on magnetic antennas.

The code sensor forms individual information frequency pulses (frequency code) with the required deviation Δf_s and duration T_s from the total frequency spectrum of the sounding signal. In order to encode the decimal digits of the number of the moving object, a redundancy-free binary code is used. Each individual radio pulse with LFM carrier can be represented by the expression

$$S(t) = A_k(t)S_0 \cos [\omega_s t + (\gamma t^2/2) + \phi_k(t)], \; -T_s/2 < t < T_s/2, \tag{1}$$

where ω_s is the average carrier frequency of a single radio pulse; $A_k(t)$ is a factor characterizing the variation of the amplitude of the reflected single radio pulse; S_0 is the amplitude of the sounding pulse; γ is the rate of variation of the angular frequency; $\phi_k(t)$ is the phase modulation law of the reflected radio pulse.

The response signals of the code pickup are received by the receiving antenna 5 and then go to the first input of the frequency converter 6. The high-frequency oscillations with step law of variation of frequency from one frequency oscillator 7 also go to the second input of this converter. The number of steps is determined by the number of circuits of the sensor, and the duration of each step is equal to the duration of an information pulse.

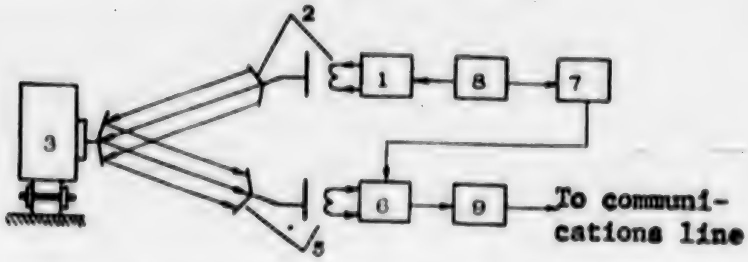

Figure 1. LFM signal shaper.

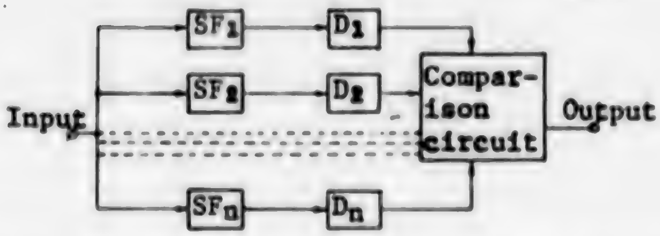

Figure 2. Optimal signal processing system.

For simultaneous arrival at the frequency converter of information pulses with linear frequency variation and reference pulses with stepped frequency variation at the converter output, the intermediate frequency signal ω_{inter} occurs in the form of pulses with LFM carrier and invariant spectral boundaries. The basic and the reference frequency generators are started from a common master oscillator 8. The output signals of the frequency converter are amplified in the intermediate frequency amplifier 9 and then are transmitted successively from its output over the communications line to the computer center to the identification unit for optimal processing.

The described system for receiving complex signals has been checked out experimentally. The sounding signal duration is 1,650 microseconds (for an eight-digit number and synchronizing pulse), and the signal frequency spectrum is from 15 to 35 MHz. The code sensor contains three oscillatory circuits (frames). The duration of an information pulse is 50 microseconds, and the frequency deviation is

600 kHz. The digital-to-analog frequency spectrum of the reference oscillator is from 30 to 50 MHz. The number of steps is 33. The average intermediate frequency is 15 MHz.

Signal Processing Algorithm. From a series of answering elements, the computer center will receive n different orthogonal complex signals $S_1(t)$, $S_2(t)$, ..., $S_j(t)$, ..., $S_n(t)$ over one or several communications lines, the processing of which must be carried out by one device. At the input of the optimal receiver, the oscillation will take place which is the sum of an individual signal and additive noise, that is,

$$X_j(t) = S_j(t) + N(t).$$

From the theory of statistical solutions it is known that all the statistically optimal procedures for distinguishing digital signals in the presence of interference reduce to comparing n correlation integrals [9]

$$J_k = \int_0^{T_s} X_j(t) S_k(t) dt, \tag{2}$$

calculated for all values of $k = 1, 2, \ldots, j, n$, where $X_j(t)$ is the received oscillation formed by one of the signals and the interference; S_k is the model of the sample stored in the receiver.

If the oscillation $X_j(t)$ is formed by the signal $S_k(t)$ and the interference, and the energies of all n signals are identical, then the following condition is satisfied with high probability

$$\int_0^{T_s} X_k(t) S_k(t) dt >> \int_0^{T_s} X_j(t) S_k(t) dt, \; j \neq k, \tag{3}$$

in accordance with which the receiver calculates the mutual correlation function of the received signal $X_j(t)$ with all n reference signals and outputs the solution that a signal has arrived from the sensor for which the correlation has the largest value.

Figure 2 shows the structural diagram which implements the optimal signal processing algorithm (2). This system contains n matched filters (SF) corresponding to n individual signals. At the output of each filter, voltage is received proportional to the correlation function (2). The voltages from the output of the matched filters at the reckoning time $t = T_s$ go to the comparison circuit that selects the signal $S_k(t)$ for which the largest voltage is obtained. By arguments of simplifying the receiver, the calculations are performed not by fast oscillating mutual correlation functions, but by their envelopes. For this purpose n linear detectors (D) are used.

It is possible to process the signals coming from moving objects over the communications line using electronic means, computers and acousto-opticoelectronic devices. It is complicated to process a large number of complex signals (more than [illegible]) by electronic means, for the corresponding set of matched filters is needed. The manufacture of such filters even for one LFM signal based on analog circuits

is a complex problem inasmuch as it is necessary to create a special frequency (or pulse) characteristic of the filter. The application of computers for these purposes is limited by insufficient speed and high cost [10]. The most available methods of optimal signal processing are the opticoelectronic devices having two degrees of freedom opposite to the electronic devices (two independent variables). For uniform transformations, the second independent variable is used for simultaneous processing of a set of uniform signals. The advantages of using the optical methods of processing in systems for automatically reading information from moving objects can be considered to be the following [11-13]:

a. the possibility of processing a large number of signals (50 to 100);

b. the possibility of simultaneous processing of all parts of the signal which is especially valuable for its signals, the duration of which is too large (T_s > 10 microseconds) for processing in real time using ordinary electronic devices;

c. the possibility of operating on frequencies reaching 1 GHz or more (passband > 100 MHz), which permits use of in practice any frequency band for read purposes;

d. simplicity of realizing spectral, correlation signal transformations (lenses, layers of space, photo transparencies, diagrams, slits, and so on appear as the converting elements), which greatly simplifies the development of the moving object recognition device;

e. high information transmission speed (with the speed of light);

f. simplicity of synthesizing in practice any required frequency-phase characteristic, that is, the optical filtration system can be built with any transmission function.

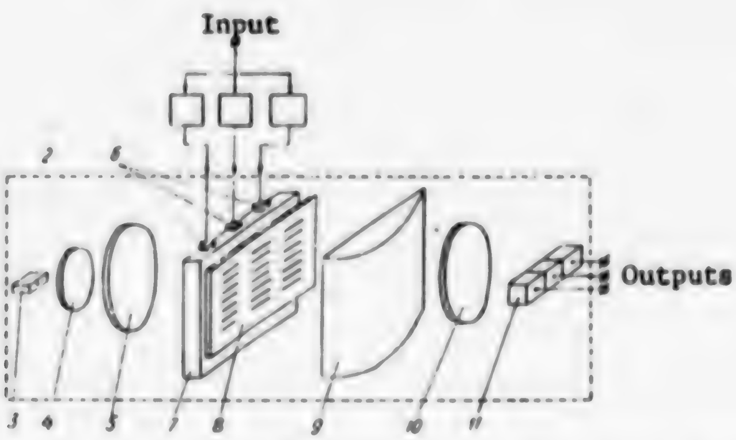

Figure 3. The multichannel opticoelectronic complex signal processing device.

Opticoelectronic Device for Processing Complex Signals. On the basis of the described structural diagram of the optimal receiver it is possible to construct a recognition unit for n orthogonal complex signals $S_1(t)$, $S_2(t)$, ..., $S_j(t)$, ..., $S_n(t)$ coming over one or several communications lines from different answering

elements using opticoelectronic matched filters. Figure 3 shows the diagram of a multichannel optical filter 2 developed in accordance with [8], in which a multichannel ultrasonic light modulator is used as the input device permitting processing of the signals in real time and consisting of piezoconverters, optically transparent medium (light and sound conductor) and absorber. The piezoconverters are needed for excitation of sound waves in the light and sound guide, and the absorber is used to create traveling wave conditions.

The input signals of the type of (3) are fed through frequency filters 1 to the corresponding piezoconverter 6 of a multichannel ultrasonic light modulator 7. A filter mask, a static transparency 8 (for example, a photographic film or photographic plate) with recording of standard signals for all answering elements is placed behind the light modulator.

The filter mask plays the role of an optical memory.

The light modulator and filter mask are successively exposed to a parallel light beam created by a monochromatic (laser) light source 3 and formed by a collimator system consisting of two lenses 4 and 5. On passage through the ultrasonic light modulator, the light beam is modulated with respect to each of the channels by the input signal, and on passage through the filter mask, it is also modulated by an etalon signal. The resultant modulation is determined by the product of these signals. The obtained light distribution using cylindrical 9 and spherical 10 lenses are focused on the rule of the photoreceivers 11. This pair of lenses performs a Fourier transformation with respect to the coordinate x, at the same time as only transfer of the image from the plane of the transparencies to the recording plane takes place along the y coordinate, by which natural separation of the signals is achieved.

The described system for a complex signal processing opticoelectronic device was checked out experimentally in a single-channel version. The LFM signal was processed in the presence of simulated receiver noise. An ultrasonic light modulator was excited at a frequency of 15 MHz with deviation of 0.5 to 1.0 MHz. The amount the signal exceeded the noise at the matched filter output was about 30.

The use of complex signals for reading and transmitting information and correlation methods of processing them using opticoelectronic matched filters permits the following qualitative indices to be obtained. For commensurableness of the powers of the useful signal and interference at the filter input the amount the signal exceeds the interference at the output reaches 60 or more. The probability of erroneous recognition of one decimal digit for a value of $B_s = 30$ and $\Delta f_s = 600$ kHz is no worse than 10^{-7} [14]. The compression coefficient of the input pulses is equal to the signal base, which permits a decrease in the transmitter power of the answering elements also by B_s times. For $\Delta f_s = 600$ kHz, the time resolution will be $\delta(t) \approx 2.2$ microseconds. This means that two input LFM signals will be distinguished if the time shift between them is no less than $\delta(t)$. The frequency resolution for input signal duration with LFM carrier T_s = 50 microseconds will be $\delta(f) \approx 170$ kHz. In other words, the carrier frequencies of the input signals must differ by no less than $\delta(f)$.

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10845
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UDC 681.325.6

INDUSTRIAL TEST DESIGN AUTOMATION SYSTEM

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
(manuscript received 20 Oct 80, after revision 21 May 81)
pp 37-42

[Article by Oleg Fomich Nemolochnov, doctor of technical sciences, Arkadiy Yefimovich Usvyatskiy, candidate of technical sciences, Viktor Fomich Zvyagin, candidate of technical sciences, and Vladimir Nikolayevich Golynichev, graduate student, LITMO, Leningrad]

[Text] Raising the level of unification and complexity of digital devices has led to a gap between practical requirements and theoretical possibilities. The described test design automation system (SAPT) provides for automatic generation of tests for the circuit boards of digital devices (TEZ).

The basis for the system is a regular method of test synthesis [1-4], a distinguishing feature of which is planning of the controlling properties and analytical calculation of the test series free of critical signal competition. The method ensures uniform results while reducing the list of failures in the test synthesis process.

Concepts. The SAPT is oriented to industrial application in organizations dealing with the development of digital systems and (or) their production. During the operating and maintenance process in a number of organizations the SAPT has recommended itself well as a system which provides effective test generation, has universal application in design practice, and has the possibility of connection to the SAPR [automated design system] available to the users, and, in addition, it is simple to operate.

Effective test generation has been achieved as a result of program execution of an analytical method of synthesizing test sequences free of critical competition [4]. During the process of developing the test synthesis technique, a great deal of attention was given to the problems of reducing the sort [1, 3], which, accordingly, made it possible to obtain a test design time acceptable for practice (from several hours to tens of hours on the YeS1022 computer). As a rule, the synthesized tests are characterized by a high percentage of completeness of monitoring the relative class of identical constant failures (98 to 100 percent).

In connection with the fact that the SAPT cannot guarantee complete tests for any systems, the possibility is provided for output of a failure list not monitored by the test. The list can be used for further development of the test, improvement of the monitoring capacity of the system, if the design cycle has still not been completed, and can also be transmitted to the SAPT developers for improvement of the method, algorithms and software.

Let us note that manual test design or development of tests obtained automatically is in practice unacceptable for the majority of systems used at the present time, and therefore when tests with about 70-percent completeness were obtained for certain circuit boards, the list of failures not checked by the test was used to modify the programs and the systems.

The test synthesis method implemented in the SAPT is characterized by the structure of the test in the form of a set of segments. A segment is a series of sets with planned monitoring properties. In the general case the segment includes the adjustment and test sequences. The presence of an adjustment sequence in each segment makes it possible to send them independently of each other.

The language used in the system is oriented to description with respect to the theoretical circuit diagram on the level of connecting the unified circuit cases without any preliminary layout of the drawing. Expenditures of qualified engineering labor are excluded in the system description phase as a result of the simplicity of the language and arbitrary order of description of the drawing. Even if the description of the system is done manually (and this unavoidably leads to errors), then it is possible to avoid the use of the erroneous description by the proposed and implemented simple procedure. It is proposed that the users execute two independent descriptions which are then compared by the program. The possible punch errors are discovered by syntactic and semantic monitoring means.

On the level of joining the cases the description presupposes the presence of a library of circuit modules. Any system described in the SAPT input language can be put in the module library.

Connection to the SAPR permits exclusion of the process of describing the circuits. Files containing a description of the covering of the logical unified circuit or information about the integrated circuit connection obtained on the level of the commutation and installation design can be used. Inasmuch as the monitoring equipment is quite varied, and the printed forms for output of the tests are in practice unique at each enterprise, the SAPT programs do not include the programs for outputting the tests to external carriers. There are standard access programs to the output information about the circuit and the test. They can be used for translation of the test to the format of the monitoring equipment available at the enterprise or when connecting the SAPT to the automated digital circuit diagnostic system.

The test synthesis program is designed to process both combination and asynchronous series circuits without significant restrictions on the circuit structure in practice.

The universalness of the application of the system is also ensured by orientation toward the use of an easily filled library of descriptions of unified circuits (at the present time the library contains descriptions of the series 133, 134, 106, 155 and 500 unified circuits) and the presence in the input language of the description means of circuit engineering and process peculiarities: the constant and accelerating voltage circuits, doubled and unused contacts, and wiring logic.

The SAPT programs are designed for the unified system of computers beginning with the YeS1022 model. The standard means of the operating systems of the unified system are used. The functional possibilities of the SAPT are realized using specially developed catalogued procedures having defined flexibility with respect to the makeup of the computer (for example, the number and type of NMD [magnetic disk storages]). The use of catalogued procedures permits the user to operate the system without detailed study of the operating system of the unified system. The software includes means of automatic statistical data gathering for the processed circuits. Operating reliability is achieved by built-in means of checking the correctness of the processed information.

Area of Application. As has already been noted, the SAPT is designed for automated design of check tests for circuit boards (TEZ) of digital devices. The test is designed to check single constant failures. The test sequences are designed for failures that appear without critical signal competition. No provision is made to test the redundant circuits of the system. In the case of process redundancy connected with special technical specifications for the application of the microcircuits (for example, double contacts, constant value circuits), provision is made for monitoring the presented failures of the redundant structure. Redundancy in the TEZ leads to reduction of completeness of the monitoring.

Synthesis of the test is a complex theoretical problem. The absence of an exact solution to certain problems also can lead to a reduction in completeness of the tests. By varying the diagram of the TEZ, for example, introducing additional mounting inputs and outputs, by coupling the feedback circuits out to a plug, it is possible to facilitate the problem of synthesizing the test and to create conditions for monitoring failures not checked in the initial TEZ.

On completion of synthesis of the test in the SAPT, provision is made for output of a list of unchecked failures in terms of the input-output contacts and microcircuit contacts. The received information makes it possible to improve the monitoring capacity of the circuits and to improve the SAPT algorithms and programs.

In the SAPT there are no restrictions on the structure or presence of branches and feedback circuits. It is not necessary to identify the flip-flops and synchronization circuits in the input description. At the present time fragments of circuits containing pulse signal generators and circuits with pulse signals are not processed if potential representation of the pulses is not permitted. The feedback circuits must be closed via flip-flops of the R-S, J-K, D, D-V type. In connection with the theoretical limitations on the synthesis method, the circuits cannot be processed which do not have initial adjustment.

The violation of the enumerated restrictions is usually recorded by the SAPT programs and is output in the form of messages. However, situations are possible where violation of the restrictions leads to large expenditures of time on test synthesis and to reduction of the completeness of monitoring.

The designed test consists of segments, the number of segments depends on the structure of the circuit (usually tens to hundreds). A test segment consists of one or several sets, the first of which is clearing the circuit. The segment nature of the test facilitates implementation of the hardware and software in the controlling production complex. The test can continue to be sent to the system from any segment. If the stand operates from PL [punch tape], it facilitates breakdown of the PL into parts. If the stand operates from magnetic tape or magnetic disk, the size of the ready-access memory buffer for storing the test is decreased. The segment nature of the test permits elimination of criticalness of the monitoring complex with respect to the number of sets in the test.

The input and output signals in the designed test are encoded in the alphabet 0, 1, x, where 0 and 1 give the logical level of the signal, x for the input signal denotes arbitrary logical level of 0 or 1, and for the output signal, a value not subject to monitoring.

The SAPT has a number of quantitative restrictions:

a. the number of contacts on the circuit board plug no more than 240;

b. the number of microcircuits on the board no more than 100;

c. the number of logical circuit gates no more than 2,000;

d. the number of sets in a segment no more than 30;

e. synthesis time of a mounting sequence set no more than 250 seconds;

f. synthesis time of a checking sequence set no more than 100 seconds.

Organizational Principles. The SAPT is a system of information connected programs. The recordings processed by the SAPT programs are identified by switches.

The programs can be executed under any conditions. Logically connected information processing operations for processing information about the system are performed by successive execution of the SAPT programs and the service programs of the operating system of the unified system. The series of programs with given conditions and input and output information switches will be called the operation of the SAPT. Among the basic operations are the following: monitoring and comparing descriptions, construction of a model, synthesis of a test, output of the test.

The SAPT programs use common systems information which is stored in file beta and information about the system which is stored in file alpha. Descriptions of the integrated circuits used in the circuitry, descriptions of the SAPT operations and descriptions of the tables of correspondence of the plugs in the circuitry to

the monitoring equipment channels are stored in file beta. The structural-logical model of the circuit and synthesized test are stored in file alpha. The sequence of processing the information by the SAPT programs is illustrated in Figure 1.

The SAPT operates under the operation loader control which successively loads the operation initiator, reading a description of the operation from file beta and the programs realizing the operation steps. The operation description is a series of operation step descriptions. The operation step includes the step number, the name of the executed program, the conditions of executing subroutines, processed data switches. If correction information is given, the operation indicator changes the operating conditions or switches in the operation step description.

The execution of any SAPT program begins with reading a description of the step and ends with writing the number of the executed step and the level of "grossness" of the error in the circuitry description in file alpha, which determines the expediency of performing subsequent steps.

In the test synthesis phase, the system is a set of macroelements and the relations between them. The combination and series macroelements are distinguished. The logical function and structure of the macroelement are depicted by equivalent cubic coatings [2]. The relation of the model to the initial description is realized using correspondence tables stored in file alpha.

Operation and Maintenance. The process of designing tests for a set of digital circuit boards is divided into two steps: the performance of preparatory operations and current operation and maintenance.

In the preparatory step the users must study the language of the description of the circuits (usually in the example of the simplest circuit or a circuit for examination by the person conducting the study) and interaction of the SAPT with the operating system of the unified system. Simultaneously, an analysis is made of the set of circuits, as a result of which the conclusion of the possibility of using SAPT is given for each circuit. During the analysis process, unified circuits are discovered, descriptions of which are absent in the library. When the circuit is executed from one crystal instead of unified circuit cases, it is necessary to select repeated fragments of the circuits as the elementary modules. The available module library is filled with new circuits. All of the newly introduced modules can be represented in the form of the gate connections of the AND, AND-NOT, OR, OR-NOT type or the modules described in the bibliography.

As operating practice demonstrates, special attention must be given to describing new modules. Any permitted inaccuracy is repeated automatically both for the individual circuit and for the entire set. The cause of error is hidden in noncorrespondence of the gate equivalents to the electric circuits.

The errors in the circuitry of the modules can be excluded if inclusion in the library is preceded by checking the adequacy of the models to the physical analogs which is done using the SAPT by synthesizing tests for the modules and subsequent analysis of them by qualified systems engineers. The users of the system

must develop programs for outputting the tests on external carriers in the format of the monitoring equipment used and (when joint use of the SAPT and SAPR is planned) translators to the SAPT language.

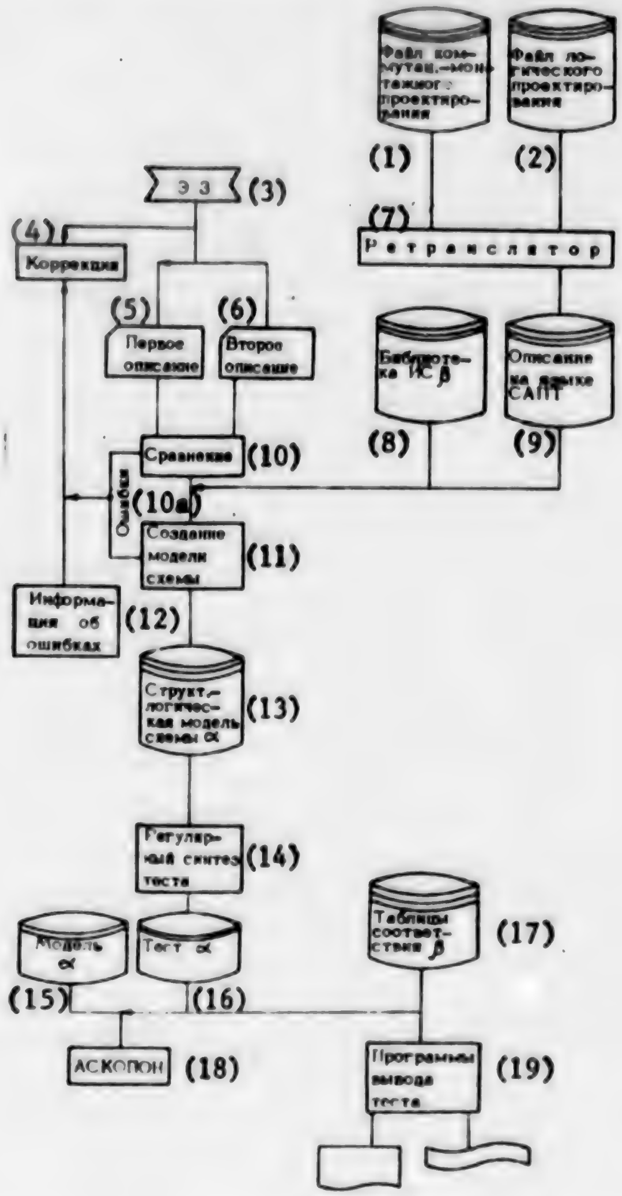

Figure 1. Information chart of the SAPT.

Key:
1. Switching and wiring design file
2. Logical design file
3. EZ
4. Correction
5. First description
6. Second description
7. Translator
8. Unified circuit library beta
9. Description in SAPT language
10. Comparison
10a. Errors
11. Creation of circuit model
12. Error information

Key to Figure 1 (continued)

13. Structural, logical model of the circuit alpha
14. Regular test synthesis
15. Test alpha
16. Model alpha
17. Correspondence tables beta
18. ASKOPON
19. Test output programs

The preparatory step includes construction of tests for two or three circuits from the set and ends with compiling operating instructions for working with the system in accordance with the enterprise requirements.

During the process of current operation, operations are performed with respect to description of the circuit boards, checkout of the descriptions, operation and maintenance of the SAPT software. In this phase a qualified specialist in systems engineering is called on to analyze failures in the systems discovered by the programs and certify the obtained tests for correspondence to the monitored objects. It is recommended that the SAPT operating groups include the programmer who develops the test output programs and the translators, a systems programmer having experience in working with the operating system of the unified system, a specialist in systems engineering, and no less than two operators describing the circuits. Let us consider the diagram presented in Figure 2. A description of the circuit in SAPT language looks as follows:

```
FRAGMENT OF REAL TEZ
CIRCUIT BOARD:EXAMPLE;
UNIFIED CIRCUIT DESCRIPTION
Ye406-2V:12/08S, 13/12S, 14/36S;
*:15/152V;
Ye410-1N:09/25S, 10/40S, 12/121N;
Ye402-2T:12/36S, 13/37S, 15/152T;
Ye434-2Kh:07/121N, 04/2503, 03/032Kh;
I-3:01/152V, 02/152T, 25/2503;
PLUG DESCRIPTION
BOX-S:08/08S, 12/12S, 36/36S, 25/25S,
40/40S;
BOX-C:37/37S, 42/032Kh;
ADDITIONAL INFORMATION
ABOUT CORRESPONDENCE OF THE NAMES OF TYPES OF UNIFIED CIRCUITS
TI:500 LM02=Ye402;
TI:500 LYe06=Ye406;
TI:500 LL10=Ye410;
TI:500 TM34=Ye434;
```

Comments are entered in the first row of the description. The information rows, in contrast to the comments, contain a blank in the first position and end with ";". In the remaining positions the blank is not a significant symbol. In the first row the key word PLATA [CIRCUIT BOARD] is the system identifier which is a series of no more than 20 arbitrary symbols of the DKOI code differing from the separator symbol ";".

A description of the system in subsequent rows can be divided into a description of the unified circuit connections, the connections of the circuit plugs and additional information. A description of the unified circuit (or plug) consists of the name of the type of unified circuit (for the plug, fixed type KOLODKA [BLOCK]), a distinguishing identifier and list of contacts. The name of the type is separated from the identifier by the symbol "-", and the identifier from the list of contacts, ":".

The list of contacts is constructed in the form of a series of descriptions of the contacts separated by commas. If the list of contacts continues in the next row, then instead of the "name of type--identifier" the symbol "*" is installed. A description of the contact includes the number of the contact and the identifier of the circuit connected to the contact. The number of the contact is separated from the circuit identifier by a slash. All of the electrical connections of one signal source are considered to be a circuit. The principle of formation of the circuit identifier is indifferent. It is convenient to name the circuits by the signal source as was done in the investigated example.

The additional information can include descriptions of the correspondence of the names of the types of unified circuits in the systems library and in the list of unified circuit connections (TI rows in the example), a description of the contacts of the constant logical values, and the accelerating voltage contacts. The procedure for describing the unified circuits and contacts in the contact list and also the row of like additional information is indifferent. The latter permits not only syntactic, but also semantic control when comparing two independently performed descriptions.

After the circuit description is checked out, a structural logical model of the circuit is constructed in the file on magnetic disk [4]. The assignment for construction of a model consists of a reference to the catalogued SAPT procedure. A description of the circuit can be selected by the procedure from the library or from punch cards from the input flow. The expenditures of machine time on constructing the model, as a rule, do not exceed 10 to 30 minutes. The assignment for synthesis of the test also consists of referencing the catalogued SAPT procedure. Inasmuch as the test synthesis can require large expenditures of machine time, in the synthesis program provision is made for the possibility of automatic continuation of the calculation after interrupt.

The test designed by the SAPT for the circuit in Figure 2 is presented in Table 1.

Industrial Operation Experience. The SAPT was put into operation in a number of enterprises and, in particular, by the Minsk production association of computers where the SAPT and automated system for monitoring and finding failures (ASKOPON) [5] were introduced into the production cycle (the latter is used in the TEZ production shop). At this enterprise a translator was created from the circuit description language in the unified automated design system to the SAPT input language. The SAPT was used to design the TEZ tests of the processors of the YeS1060 and YeS1035 computers which are series-manufactured by this association. The tests designed by the SAPT, and the circuit models make up the information support of the ASKOPON. The ASKOPON and the SAPT are oriented to use of the same

YeS1022 computer and are matched with respect to data formats, in connection with which there is no necessity for outputting the test on punch carriers. All the synthesized tests and models are placed in an archive and are available from each troubleshooter's workplace.

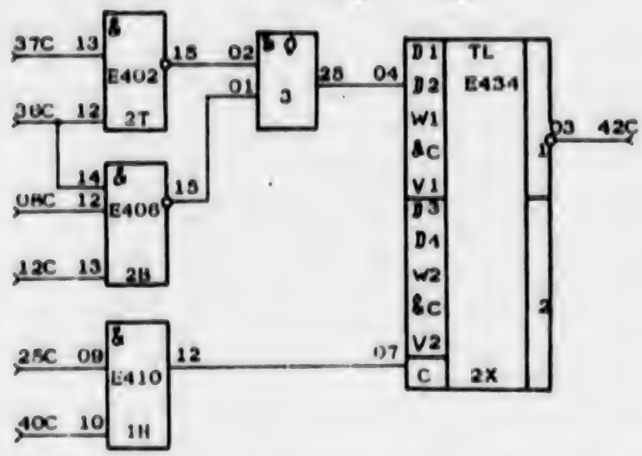

Figure 2. Fragment of the theoretical circuit diagram E3: Ye402, Ye406, Ye434--names of types of unified circuits; 2T, 2V, 1N, 2Kh--identifiers of unified circuits; 3--wiring identifier I.

Table 1

Segment	Set	Plug Contacts 8	12	25	36	37	40	42
1	1	0	1	1	1	0	1	0
2	1	0	0	1	0	1	1	0
	2	0	0	0	0	0	1	0
	3	1	1	1	1	0	1	1
3	1	1	0	1	1	0	1	0
4	1	1	1	1	0	1	1	0
	2	0	x	0	0	1	1	0
	3	0	1	1	1	1	1	1
5	1	1	1	1	1	1	1	1
	2	x	x	1	0	1	1	0
6	1	1	1	1	1	1	1	1
	2	1	1	0	1	1	1	1
	3	x	x	0	0	1	1	1
7	1	x	x	1	0	1	1	0
	2	x	x	1	0	1	0	0
	3	1	1	1	1	1	0	0

The workplace is equipped with an alphanumeric display, a program-switched contactor for connecting the TEZ and a digital multilevel single-contact probe. The ASKOPON software realizes a number of conditions that are available by request of

the troubleshooter: monitoring, automated diagnostics (active computer), step-by-step diagnostics (troubleshooter active), output of the unified circuit connections, output of the standard values, and so on.

Table 2

Characteristics of States	Processor TEZ YeS1060	Processor TEZ YeS1035
All types	228	160
Descriptions presented	271	114
Model constructed	261	100
Synthesis completed	249	84

Data are presented in Table 2 on the TEZ of the YeS1060 and YeS1035 computers with respect to the condition at the end of the first year of operation of the SAPT in the production association. For the YeS1060 operations began earlier; therefore the results are more complete for it. In connection with the edited changes, 47 types of TEZ of the YeS1060 were presented for test design repeatedly.

The negative results in the model construction phase correspond to output of m -sages regarding violation of the systems engineering restrictions of the SAPT (two TEZ operating with respect to a ring of states, one TEZ contains a pulse oscillator, six TEZ have functional redundancy, one TEZ does not have information inputs). For six of the emergency messages, the TEZ developers confirmed violations of the technical guidance materials for the use of the series 500 unified circuits.

The completeness of the designed tests, as a rule, is 98 to 100 percent and basically satisfies the production requirements. The designed tests are effective when monitoring and finding not only single constant failures, but also short circuits and multiple failures. The test synthesis time varied within a broad range (from minutes to several tens of hours) and in a majority of cases it was 1 to 3 hours on the YeS1022 computer. In 12 cases synthesis was not concluded in view of the large expenditures of time or it was terminated at the 70- to 90-percent level. As preliminary analysis of the TEZ circuits demonstrated, large expenditures of time and low percentage of completeness for individual circuts are connected with the presence of redundant lines, for which the test sequences do not exist. Large expenditures of time are explained by the necessity for performing a complete sort to discover the redundancy.

In the test certification step, the analysis is performed for correspondence of reaction of the failed TEZ to the standard value in the test designed by the SAPT (three noncorrespondences of the TEZ editing and descriptions were detected, three unified circuit descriptions were incorrect, and cases of using nonlogical unified circuits were discovered).

The obtained data (emergency messages when constructing the model, large expenditures of time when synthesizing the test, information about incompleteness of the test) are the basis for improving the TEZ systems on the level of improving their monitorability. The statistical data coming to the LITMO are promoting improvements in the algorithms and operating characteristics of the SAPT.

Prospects for Development of SAPT. For development of the SAPT it is proposed that the dimensionality of the processed circuits be increased to 4,000 gates. Introduction of models of such systems engineering elements as two-directional lines, improvement of the methods of reducing the sort, development of the methods of automatic reduction of dimensionality of the circuits as a result of their regular structure will permit expansion of the area of application of the SAPT to large unified circuits and circuit boards with large unified circuits.

The authors express their appreciation to V. A. Karabanovich for supplying data on the operation of the SAPT at the Minsk production association of computer engineering.

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10845
CSO: 1863/60

BRIEFS

ACHIEVEMENTS IN PENZA--At the Penza Computer Plant the results of four weeks of accelerated work dedicated to the 60th anniversary of the founding of the USSR were totalled up and it was found that the pace of production had grown noticeably compared to that of the previous weeks. November's plan for computer production had been exceeded by almost 10%. "The secret is," explained Yu. Bykovets, engineer of socialist competition, "that the new conditions of labor rivalry contain powerful incentives to increase production efficiency. These incentives are both moral and material." The results of the competition are tallied every five days and are immediately widely publicized by posting them on plant and shop display stands headed "Journal of Accelerated Labor Shifts." Winners are granted incentives monthly. And the collectives which emerge as leaders on the basis of results for the whole 60 week period will receive pennants and certificates to keep permanently; monetary awards have been established for them. The instrument builders decided, ahead of schedule, in December 1982, to release an industrial batch of new computer complexes with larger "memory" capacity, to raise the stock of series machines, to increase production of consumer goods by 200,000 rubles next year, to save not less than 5.1% of electrical energy consumed and to expand the stock of spare parts for agriculture machines supplied to the villages significantly. [By A. Zakharov, division chief of the regional newspaper PENZENSKAYA PRAVDA] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 9 Dec 81 p 1] 9285

AUTOMATED DESIGN IN LITHUANIA--Kaunas. The time required to design computers has been decreased significantly at the Vilnius Computer Plant imeni V. I. Lenin. All design work in the plant design bureau and in technological preparation for production has begun to be performed by computer. This innovation was introduced by the scientists of the Kaunas Polytechnical Institute. The system of automated machine design they developed reduces the amount of engineering and technological labor by a factor of 30-40. Great labor savings is also being achieved through avoidance of design errors, to which even the highly qualified specialist is not immune. With this program, the computer controls itself at every stage of work. This development will be applied in the creation of a new generation of computers, precision electronic instruments and high precision radiometric apparatus. [Text] [Moscow PRAVDA in Russian 6 Nov 81 p 3] 9285

MINSK - 32--The "Minsk-32" computer has been in use from December 1974 to the present. To supplement the basic unit one can purchase an alphanumeric printer ATsPU - 128, two magnetic tape units NML - 67, a device for inputting data from punched tape, a group control block KSU - 2, and "Minsk - 1560" hardware. Address inquiries to: 290019, L'vov-19, ulitsa Dekabristov, PO "Progress", telephone: 52-19-40, 52-11-07. [Text] [Moscow EKONOMICHESKAYA GAZETA in Russian No 40, Oct 81 p 3] 9285

USSR - HUNGARY COMPUTER LINK--Leningrad. Results of basic research and applied development which are stored in the memories of Leningrad and Budapest computers, from now on, are accessible to leading scientific centers in those cities. Today an experimental line for transmitting computer information has been put into use to connect the Leningrad Scientific Research Computer Center of the USSR Academy of Sciences with the "electronic brain" of the Research Institute of Computer Technology and Automation in the capital of Hungary. This will facilitate further integration of the efforts of Soviet and Hungarian specialists in various sectors of the economy, particularly in the preparation of standardized software for industrial robots. [By TASS correspondent N. Krupenik] [Text] [Moscow GUDOK in Russian 5 Dec 81 p 1] 9285

ELECTRONIC CALCULATORS--Ryazan'. High speeds and quality of economic information processing is provided by the electronic business calculators "Iskra - 555". The first batch of these "great great grandsons" of abacuses were made in the Ryazan' Plant for Calculators and Analytic Machines. The memory size of the electronic business calculators has been increased markedly and the range of its operations has been expanded. Provision has also been made for transmission of information along a communication link at a distance of up to 15 kilometers. Moreover, the "Iskra - 555" is multipurpose; it can process business calculations, and statistical and planning information for all sectors of the economy to serve the population. [By A. Trofimov, TASS correspondent] [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 30 Oct 81 p 2] 9285

ASU FOR IRTYSHSK SHIPPING LINE--Omsk. The first ASU (Automated Control System) has been accepted for industrial use in the Irtyshsk shipping line. It is made up of nine sub-systems, including "On-line recording and analysis of fleet operation", "Calculation of the movement graph" and "On-line recording of cargo and passenger transport". Specialists have calculated that the yearly savings attributable to the tasks performed by the first ASU will amount to more than 260,000 rubles and that the system will pay for itself in less than three years. [Text] [Moscow VODNYY TRANSPORT in Russian 3 Dec 81 p 4] 9285

CSO: 1863/70

DATA PROCESSING IN PARALLEL

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
pp 135-136

[Article by Vitaliy Petrovich Boyun, candidate of technical sciences, Cybernetics Insitute of the Ukrainian SSR Academy of Sciences, Kiev, Vladimir Vladimirovich Gritsyk, candidate of physical and mathematical sciences, Physicomechanical Institute of the Ukrainian SSR Academy of Sciences, L'vov, and Leonid Grigor'yevich Kozlov, candidate of technical sciences, Cybernetics Institute of the Ukrainian SSR Academy of Sciences, Kiev]

[Text] The Third All-Union Seminar on Data Processing in Parallel organized by the Scientific Council on Computer Engineering and Control Systems of the State Committee on Science and Engineering of the USSR and the Presidium of the USSR Academy of Sciences, the Scientific Council for Simple Pattern Retrieval and Recognition of the Presidium of the Ukraining SSR Academy of Sciences, the Moscow Physicotechnical Institute, the Cybernetics Institute of the Ukrainian SSR Academy of Sciences, the Physicomechanical Institute of the Ukrainian SSR Academy of Sciences, the Western Science Center of the Ukrainian SSR Academy of Sciences and L'vov Oblast Board of the Priborprom Scientific and Technical Society was held from 10 to 15 March 1981, in Yaremcha of Ivano-Frankovskaya Oblast.

The work of the seminar was participated in by 178 specialists from 68 organizations of 26 cities of the country. At the plenary sessions and in the stock sections, 152 reports were heard containing new results from research and development in information processing in parallel.

At the plenary sessions, 28 reports were presented. The survey report by doctor of technical sciences S. Ya. Vilenkin (Moscow) was on the modern state of the art and trends in the development of multiprocess and problem-oriented parallel-action computer systems. The speaker accented the attention on the fact that the application of parallel computer systems with a common instruction flow requires a theoretically new approach to constructing the computation algorithm. The speaker familiarized the seminar participants with some of the completed parallel-action systems developed at the Control Problems Institute of the USSR Academy of Sciences.

In the survey report by doctor of physical and mathematical sciences A. N. Kostovetskiy (L'vov) a study was made of the structural-time paralleling and basic approaches to improving the efficiency of data processing were defined.

The stock reports were discussed in five sections. In the reports of the first section on "Efficiency and quality of paralleling algorithms in data processing systems," a study was made of the implementation of algorithms on parallel-action multiprocessor systems, and the possibilities for increasing the data processing efficiency were proposed.

In the report by candidate of physical and mathematical sciences V. V. Gritsyk (L'vov) results were presented from studies to determine the classes of algorithms permitting deep paralleling of information processing, and the theoretical-information problems of paralleling are investigated. On the basis of the theory of partially recursive functions, definitions of paralleling on the given level are presented, and classes of algorithms permitting line data processing are presented.

A report by V. A. Val'kovskiy (Novosibirsk) dealt with approaches to accelerating calculations when paralleling the cycles. A study was made of paralleling by the method of hyperplanes, the coordinates of parallelepipeds and pyramids. The most effective method of paralleling was selected as a function of the type of computer, number of processors and nature of the cyclic section.

In the reports of the section on "Uniform computer media. Architecture and implementation," it was noted that intense studies are being conducted in the field of the theory of adjustable computer systems, structures and media. Methods and means of paralleling algorithms for execution on uniform computer media are being developed.

The survey report by doctor of technical sciences N. D. Ustinov and candidate of technical sciences Yu. N. Sulitskiy (Moscow) was devoted to the basic problems of adjustable uniform computer structures created on the basis of microprocessor engineering and ways of executing them. The basis for the area of operations proposed by the authors was the developed and manufactured system of uniform computer structures consisting of matrices of universal computing and storage cells based on LSI.

A survey report by doctor of technical sciences V. A. Mishchenko (Minsk) discussed the problems of constructing super-fast computing structures and media, in particular, the problems of creating an element base and methods of synthesizing it. It is demonstrated that on the basis of computer structures and media it is possible to synthesize theoretically new computer architectures operating by the principle of convolution of the input macro language operators. The discussed theoretical and practical elements of such systems are based on the principles of univerisalism formulated by the author.

In the reports of the section on "Paralleling algorithms in real-time pattern retrieval and recognition," a study was made of the problems of the development and application of specialized high-output parallel-action computers for hydrophysical, outer space and geophysical research, especially when working on moving platforms and under field conditions where the processing of large data files in real time promises great technical and economic effect.

The survey report by doctor of technical sciences I. N. Troitskiy (Moscow) discussed the results of parallel tuning of active optical elements in adaptive light field processing algorithms. It was demonstrated that the problem of finding an optimal parallel control algorithm for all optical elements is identical

to the problem of synthesizing a recurrent algorithm of the construction of estimates of a maximum plausibility function. A study was made of the possibilities of improving the known adaptive algorithms using the principle of parallel algorithms for parallel phase tuning in all active optical elements.

In the report by doctor of technical sciences P. A. Bakut and candidate of technical sciences A. A. Demin (Moscow) a study was made of the algorithm for measuring the phase distribution of a coherent light field permitting paralleling and execution on a parallel-action computer which permits a thousandfold gain in machine time and solution of the problems of recording and processing phase information in real time.

In the survey report by candidate of technical sciences T. K. Vintsyuk (Kiev), results are presented from studies of paralleling calculations in the process of analysis and recognition of speech patterns. It is noted that in order to create a voice recognition device it is necessary to develop several types of special parallel-action processors: spectral analyzers, special processors of similarity measures, processors for solving the problem of dynamic programming.

In the reports of the section on "Methods of paralleling as applied to the problems of sorting and parallel processing of information in real time," the results of theoretical studies of the development and methods of paralleling data processing algorithms were presented as applied to the solution of high-dimensionality problems using parallel-action multiprocessor systems under real time conditions.

A survey report by candidate of physical and mathematical sciences V. V. Gritsyk, candidate of technical sciences A. B. Samokhin and B. T. Derkach (Moscow, L'vov) presented theoretical results in the field of methods of paralleling algorithms when solving systems of high-dimensionality equations with resolved coefficient matrices.

In the report by candidate of technical sciences L. G. Kozlov (Kiev) a study was made of the paralleling of the algorithm for solving boundary problems on problem-oriented processors.

In the reports of the section on "Methods and means of parallel data processing," results are presented from developments in the field of the methods of parallel organization of data processing using high-output parallel-action computing means.

A survey report by candidate of technical sciences V. P. Boyun and L. G. Kozlov (Kiev) was devoted to investigation of problem-oriented parallel processors for solution of problems of mathematical physics. An approach is proposed which permits deep paralleling of the algorithm for solving partial differential equations and a significant increase in output capacity of the problem-oriented processors.

In the survey report by candidate of technical sciences Ya. I. Feta (Novosibirsk) results are presented from synthesizing dynamic parallel processors designed for hardware execution of information logic problems.

In the survey report by doctor of technical sciences K. T. Samofalov, candidate of technical sciences G. M. Lutskiy and O. V. Rusanova, a study was made of the structural organization of conveyor computer systems, and the problems of constructing

high-output and superhigh-output computer means based on the conveyor method of data processing were investigated.

A report by candidate of technical sciences A. N. Semashko (Minsk) was devoted to the problems of the synthesis and analysis of trivial multifunctional automata and also the problems of their practical application when constructing digital devices of arbitrary functionalness and when solving the problem of paralleling the computing process.

The participants in the seminar noted that the great interest of the scientists in paralleling data processing algorithms and their implementation in parallel-action computing systems is explained by the great urgency of these problems and recent intense research.

The success of the seminar was undoubtedly promoted by the good organization of the sessions and stock sections and also publication of the reports in the form of preprints (L'vov, Physicomathematical Institute of the Ukrainian SSR Academy of Sciences, 1981, preprints Nos 40-44).

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CSO: 1863/60

SYSTEMS RESEARCH IN PROGRAMMING VITAL CYCLES OF NEW EQUIPMENT ENTITIES

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
pp 136-137

[Article by Aleksandr Antonovich Nikiforov, junior scientific coworker of the Cybernetics Institute of the Ukrainian SSR Academy of Sciences, Kiev, and A. A. Rodionov]

[Text] The sixth joint seminar on systems research in programming the vital cycles of new equipment entities (ONT) organized by the Scientific Council on the Problem of Cybernetics of the Ukrainian SSR Academy of Sciences, the Cybernetics Institute of the Ukrainian SSR Academy of Sciences, the Scientific and Technical Society imeni A. N. Krylov, Kaliningrad Interbranch Scientific and Technical Information and Propaganda Center, Kaliningrad Technical Institute of the Fishing Industry and Management was held from 18 to 23 May 1981 in Kaliningrad.

The seminar was participated in by more than 100 specialists from 14 cities of the USSR representing 32 scientific and production organizations of various ministries and departments. During the seminar 60 reports and 10 brief reports were heard and discussed.

The work of the joint seminar was opened by its scientific director, doctor of technical sciences K. D. Zhuk. In his report "New problems of programming the vital cycles of ONT," Zhuk analyzed the current state of the art and prospects for solving the problem with respect to basic areas: methodology of investigating the vital cycles of ONT, methodology and theory of systems design of complex entities, mathematical models of ONT and optimization of the resources of the vital cycles of the ONT, design of the information medium and integration of automated control systems for vital cycles of complex entities, models of automation of the technical diagnostic processes, design automation systems (SAPR) for a number of machine building branches.

The following reports aroused the most interest among the seminar participants: "Basic prerequisites for the development and creation of TOR automated control systems for the fleet of the fishing industry" (Ya. G. Kuzin, Kaliningrad), "Logical apparatus of systems design" (K. D. Zhuk, A. A. Nikiforov, Kiev), "Systems methods in the design of integrated information systems for automated data processing" (V. A. Fedin, O. I. Ryakin, N. M. Krepkov, A. V. Chaban, Moscow), "Optimization of structural characteristics of complex systems as a systems design problem" (A. A. Timchenko, A. A. Rodionov, V. G. Gamayunov, Kiev), "Forecasting Support of SAPR" (O. S. Grol', Voroshilovgrad), "Construction of a generalized model of resource

dynamics" (V. G. Naumov, Kiev), "Problems of creating information systems for observing the condition of a ship's hull during operation and maintenance" (A. Ye. Pryadeyev, Kaliningrad), "Systems approach to the design of gas turbine engines" (E. B. Mats, A. P. Tukanov, Kazan'), "A systems design model" (V. A. Dekhtyarenko, Minsk), "Man-machine procedure for developing design solutions" (I. I. Taturevich, Vinnitsa), "Problems of the methodology of automated design of marine cable systems" (R. P. Orekhov, B. G. Fel'dman, Kaliningrad), "System for simulation and analysis of hardware of a complex physical nature" (K. V. Kumunzhiyev, V. V. Stoyanov, N. I. Kuz'min, Ufa), "Analysis and development of a low-level subsystem of the hierarchy of the automated TEF control system" (Yu. A. Reznichenko, Kaliningrad), "Method of monomeric optimization of the vital cycles of ONT" (V. A. Parasochkin, O. V. Tkachenko, Odessa), and so on.

The scientific directors are to prepare and hold the seventh joint seminar on "Development of theoretical apparatus, basic invariants and software for integrated programming systems for the vital cycles of large technical systems" in 1982.

Fruitful work by the seminar was promoted by the high technical level and practical significance of the reports, the broad exchange of opinions, the businesslike atmosphere, preliminary publication of the summaries of the reports. It is necessary to note the great amount of work done by the organizational committee of the seminar and the KTIRPiKh Institute which provided carefully planned and clear-cut organization of the seminar.

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SYSTEMS RESEARCH AND ITS APPLICATIONS

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
pp 137-138

[Article by Yakov Aleksandrovich Dubrov, candidate of physical and mathematical sciences, Computer Center of the IPPMM, Ukrainian SSR Academy of Sciences, L'vov]

[Text] The traditional symposium on "Systems research and its applications" organized by the Western Scientific Center of the Ukrainian SSR Academy of Sciences, the Scientific Council on the problem of Cybernetics of the Ukrainian SSR Academy of Sciences, the Computer Center of the Institute of Applied Problems on Mechanics and Mathematics of the Ukrainian SSR Academy of Sciences, the L'vov Polytechnical Institute, the Cybernetics Institute of the Ukrainian SSR Academy of Sciences, the L'vov Oblast Board of the Scientific and Technical Society of RES imeni A. S. Popov and the L'vov Oblast House of Engineering was held from 24 February to 1 March 1981 in Slavskiy of L'vov Oblast.

The work of the symposium was participated in by about 80 specialists from more than 30 organizations of different cities of the country. During the work of the seminar, six plenary and 17 section reports and also 21 minor section reports were heard.

A plenary report by V. V. Shkurba (Kiev) was devoted to the problems of system optimization. The term "system optimization" itself was introduced by V. M. Glushkov to designate modern processes of generating optimal solutions based on interactive working conditions of the specialist, efficient procedures for correcting the models servicing to develop the solutions, the approaches of informatic identification of mathematical models and decisions with orientation to the person making these decisions, coordinating the quality evaluation of the decisions with evaluating the quality of the work of the person himself. In the report a series of examples taken from production planning practice were used to demonstrate the effectiveness of this approach, and areas for the development of organizational software for automated production control systems for implementation of this type of process were noted.

In a report on the basis for the axiomatic definition of a structural-functional (SF) system, Ya. A. Dubrov (L'vov) introduced some system scructural elements (system fragment, macrosystem, subsystem), he investigated analogs of set theory operations on systems (union, intersection, complement), and he introduced system operations in a set of SF-systems (γ-connection and γ-iteration). The result obtained by the author — canonical representations of SF-systems -- has important applied significance for system analysis and synthesis.

In a report by L. G. Shatikhin (Kiev), a practical method of analysis and synthesis of system structures (the method of structural matrices) is proposed. In accordance with this method, the structure of the system is constructed in several steps: construction of the external system, development of a large-block matrix, detailing of the elements of the large-block matrix, and so on.

A report by Yu. G. Zarenin (Kiev) was devoted to the problems of mathematical description, evaluation and support of the reliability of program systems and program product and also the the problems of creating a special operating system offering the possibility of performing a solution in the dialog mode.

In a report by L. Ya. Nagornyy (Kiev) based on the methods of diacoptics algorithms were proposed for block paralleling, forming and solving a system of equations of electronic circuits and large-dimensionality systems with rarefied matrices of coefficients. The given algorithms can be used in the corresponding SAPR [design automation systems].

In his report, L. S. Kozachkov (Kiev) investigated the problems of informatics of the structure and the analysis of conceptual models of multilevel structure. Examples of systems analysis of an object of control and logical design of data bases for control problems oriented to systems optimization are presented.

The remaining reports were heard at meetings of two sections.

Among the reports presented at the subject-oriented sessions of the first section "Mathematical and applied problems of systems theory," let us note the following.

A report by Ya. A. Dubrov (L'vov) was devoted to the investigation of certain properties of global functions (macrofunctions) of SF-systems and determination of the macrofunctions of atomic systems (monad, source, discharge, copirator, and so on). It is noted that macrofunction algebra can be constructed also on the basis of some atomic system base.

The report by A. S. Nikitin (Minsk) discussed the creation of an effective mathematical apparatus for representation and processing of hierarchical graph structures and software for implementing them.

In the report by R. V. Rozhankovskiy (L'vov) a study was made of the applications of graph theory to the technical design of complex systems (cells of radioelectronic equipment based on printed circuits) with the known operation system represented in the form of a graph.

In the report by L. V. Yurin (Moscow), an approach to creation of a complex system of automated work places for processing economic data in organizational automated control systems based on their problem orientation is proposed on the basis of standardizing design solutions.

The report by V. T. Kulik (Vinnitsa) on the mathematical problems of systems theory contains, in particular, the strongest congruence relation for specific partial universal algebras with partial ternary operation, and a study is made of the properties of a partial factor algebra with respect to this relation.

In a report by Z. D. Potyagaylo (L'vov), the topology in a set of states of a dynamic system is introduced, and a study is made of the possibility of qualitative analysis of a dynamic system by topological methods.

L. P. Plakhta (L'vov) considered the problem of the largest number of maximal pair combinations and graphs, the powers of the apexes of which differ little from each other, in his report on graph theory and graph theoretical methods.

In a report by V. I. Shelepets (L'vov) devoted to the optimization, identification and diagnosis of complex systems, a study was made of the methods of solving the problems of multicriterial optimization in the cases of strict ordering and non-rigid ranking of moisture criteria.

The report by O. K. Ilyunin and Yu. A. Borovskiy (Khar'kov) was devoted to the analysis of various integral quality criteria of the work of scientific collectives, and the report by V. M. Levykin and A. D. Borovoy (Khar'kov) was on the description of information advisory monitoring and control systems for complex objects which are intended for discovering latent defects in television boards.

In a report by V. A. Zabrodskiy and A. S. Tomyakovskiy (Donetsk), a mathematical model of simulation of the process of variation of equipment reserves in time as a function of disturbing factors, was proposed.

The report by P. Ya. Kalita (Kiev) was devoted to investigation of the procedural problems of the design and application of standard procedures for analyzing information and systems information simulation of management situations for production quality control in light industry.

In the report by A. I. Yarosh (Khar'kov), an information-logic model of the applied region using a thesaurus and data models is proposed.

V. S. Chabanyuk (Chernovtsy) in his report proposed a procedure for exact solution of the problem of decomposition of the information base with respect to the criterion of minimum (maximum) information connectedness of the data sets.

Among the reports heard at the thematic sessions of the second section on "Technical and systems programming," it is possible to note the following.

In the report by B. A. Kostovskiy and T. T. Romanyuk (L'vov), a procedure based on superlanguage properties is proposed for analyzing FORTRAN programs with respect to Yanov systems, and a set of programs implementing this method was described.

The report by D. S. Khorolets (Kiev) discussed one of the methods of implementing asynchronous process control programs in the operating system of the unified system.

In a report by V. I. Parnitskiy (Kiev) a study was made of the problems of organizing file systems in which the average number of entries required to answer a class of requests with respect to certain attributes is minimal.

The report by V. I. V'yun and T. O. Dzyubek (Kiev) was devoted to the problems of designing problem-oriented computing processes for automated industrial enterprise control systems. It is proposed that a system of decision tables be used as the

formal apparatus for describing the manifold of interconnected problem situations and control inputs.

The report by G. L. Brodetskiy and A. V. Serpinskaya (Kiev) was devoted to the problems of effective use of time redundancy to improve reliability and increase output capacity of computer systems operating in multiprogramming modes with time quantization.

In addition, a number of reports were heard on topics at the juncture of different sciences, and a discussion is presented with respect to development of systems methods and use of them in the investigation of complex systems.

Holding a symposium promoted establishment of contacts among specialists with respect to systems theory, mathematical simulation, theoretical and systems programming. In a resolution attention was focused on the urgency of developing systems methods of investigation and their mathematical substantiation. The next symposium, by recommendation of the participants, will be held in 1982.

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PUBLICATIONS

ABSTRACTS FROM JOURNAL 'CONTROL SYSTEMS AND COMPUTERS', SEPTEMBER-OCTOBER 1981

Kiev UPRAVLYAYUSHCHIYE SISTEMY I MASHINY in Russian No 5, Sep-Oct 81
pp 145, 147, 149, 151

UDC 681.324

TRANSPORT STATION FOR THE UNIFIED SYSTEM OF COMPUTERS

[Abstract of article by Glushkov, V. M., Gusev, V. V., Dayen, I. L., Nikolenko, D. I., Petrukhina, L. V., Tumko, V. A.]

[Text] A description is presented of the architecture and function of a transport station -- a program controlling the reception and dispatch of messages in a subscriber computer connected to a computer network. Transport stations control the through delivery of messages between user programs executed in various subscriber computers of the network. There are 2 illustrations and 9 references.

UDC 681.3.05

PROBLEMS OF PRACTICAL CONSTRUCTION OF REGIONAL COMPUTER CENTER NETWORKS

[Abstract of article by Golyshev, L. K. Matveyev, M. T., Nikitin, A. I., Stogniy, A. A.]

[Text] A description is presented of the design principles and implementation of regional computer center networks based on hardware that is series manufactured by industry. Information is presented on an implemented three-junction network. There is 1 illustration and 2 references.

UDC 681.3.06.2

METHODS AND ALGORITHMS FOR STRUCTURAL-TOPOLOGICAL OPTIMIZATION OF CENTRALIZED DATA TRANSMISSION NETWORKS

[Abstract of article by Bolotov, A. B.]

[Text] A discussion is presented of the state of the art with respect to one of the important problems in the field of computer networks -- structural-topological optimization. The most widely used methods of optimizing centralized data transmission networks are investigated, the basis for which are discrete mathematical models. There are 34 entries in the bibliography.

UDC 621.395.74:681.3

ADAPTIVE DISPATCHING OF PROBLEMS IN COMPUTER NETWORKS

[Abstract of article by Vasil'yev, V. I. Guaryan, K. R., Konovalov, V. M.]

[Text] A study is made of adaptive systems for decentralized dispatching of user problems in computer networks with periodic information exchange about the current state and load of the network resources and under conditions of partial a priori indeterminacy of the processes in the network. Results are presented from an experimental study and comparative analysis of dispatching algorithms. There are 6 illustrations and 6 references.

UDC 681.32

A METHOD OF MEASURING COMPUTER LOAD IN A MULTIPROGRAMMING REAL-TIME DISC OPERATING SYSTEM

[Abstract of article by Batner, A. A., Krivov, V. I., Logunov, M. G.]

[Text] A description is presented of a simple method of estimating the processor load of the minicomputers M6000, M7000, SM-1 and SM-2 by applied programs during operation in a multiprogramming real-time disc operating system. The proposed method permits estimation of both the integral load and its time distribution. A block diagram of the measuring program and examples of the measurements obtained are presented. There are 2 illustrations and 1 reference.

UDC 681.321:512.5

PROBLEM OF CONSTRUCTING COMPUTING DEVICES FOR TAKING LOGS AND ANTILOGS

[Abstract of article by Tsidelko, V. D., Khokhlov, Yu. V.]

[Text] A study is made of table-algorithmic functional converters with correcting channel for obtaining the functions of a double logarithm and antilogarithm which can be used in specialized processors. A comparative characteristic of the proposed structures and table conversion is presented, and estimates are made of the size of the memory and the conversion time. The possibility of using a table of a correcting ROM to obtain both functions is demonstrated. There is 1 table, 6 illustrations and 10 references.

UDC 681.3.045.5:65.011.56

NOISE-IMMUNE CODING MODULE FOR DATA PREPARATION DEVICES IN AUTOMATED CONTROL SYSTEMS

[Abstract of article by Broydo, V. L.]

[Text] A study is made of an attachment for a data preparation unit in an automated control system that encodes the information recorded in the decimal number system in a code with automatic correction of single errors which provides for the possibility of operative and effective correction of this information in the computer. A block diagram is presented for a program for checking the reliability of information and error corrections for the computer. There are 2 illustrations and 4 references.

UDC 621.391;658.012.011.56;658.286

PROBLEM OF GATHERING, TRANSMITTING AND PRELIMINARY PROCESSING OF DATA IN AN AUTOMATED TRANSPORT CONTROL SYSTEM

[Abstract of article by Vokhomskiy, O. A.]

[Text] A study is made of the correlation method and an algorithm is presented for processing complex signals. The advantages of the acoustic-optical methods of processing the initial data are demonstrated. Experimental results are presented. There are 3 illustrations and 14 references.

UDC 681.325.6

INDUSTRIAL TEST DESIGN AUTOMATION SYSTEM

[Abstract of article by Nemolochnov, O. F., Usvyatskiy, A. Ye., Zvyagin, V. F., Golynichev, V. N.]

[Text] A system is described which provides for automatic generation of tests for digital circuit boards. Concepts used as the basis for the developed system are discussed, and the area of its application is demonstrated. The restrictions on the class of developed systems are presented. Recommendations are made with respect to operation and maintenance, and an example of the application of the test design system for the processor of the YeS1060 computer is given. There are 2 illustrations, 2 tables and 5 references.

UDC 621.3.049.75.001.24

COMPARATIVE ANALYSIS OF METHODS OF DESIGNING PRINTED CIRCUIT BOARDS

[Abstract of article by Abakumov, V. G., Serbin, S. A.]

[Text] An analysis is presented of the effectiveness of the basic methods of designing printed circuit boards by the following criteria: labor intensiveness, duration and cost of design, complexity of the circuits, complexity of constructing the circuit boards. Analytical relations are constructed for the labor intensiveness and cost of design as a function of complexity of the circuits. The optimal method for constructing series electronic equipment is defined. There is 1 table and 36 references.

UDC 681.3.06:51

LOGICAL CIRCUIT EVENT SIMULATION EQUIPMENT

[Abstract of article by Gal'chenko, O. N.]

[Text] A general diagram is proposed for construction of a specialized computer to simulate logical circuits executed on the basis of the functional bases of logical elements of standard series of integrated circuits. There are 3 illustrations and 3 references.

UDC 681.3.14/21

GENERATION OF THE TOPOLOGY ELEMENTS OF LSI

[Abstract of article by Nesterov, V. A., Shenderovich, Yu. I.]

[Text] A method is proposed for automatic formation of systems engineering elements based on assignment of a provisional configuration in a plane, the dimensions of which characterize the element parameters. An algorithm is presented for generating an n-channel MDS-transistor. There are 6 illustrations and 4 references.

UDC 539.24./27

A SYSTEM FOR AUTOMATING THE DESIGN AND PROCESS PREPARATION FOR THE PRODUCTION OF PROGRAMMED ROM FOR THE ELEKTRONIKA S5 MICROCOMPUTER

[Abstract of article by Skvortsov, A. E.]

[Text] The architecture of an automated system for integrating the development and production of programmed ROM for microcomputers as a combination of design automation modules based on the primary information archive is presented. The construction of the system is considered from the point of view of coordination of the efforts of the programmers and makers of the microcomputers during the process of gathering, conversion and storing the program information and generating a set of design plans and specifications for a microcomputer for specific application. There are 3 illustrations and 2 references.

UDC 681.325.5-181.4

CHECK SYSTEM OF A MICROCOMPUTER CONSTRUCTED ON THE BASIS OF THE K580IK80 LSI

[Abstract of article by Krasavtsev, V. A., Kaluzhskiy, A. D.]

[Text] A study is made of the problems of software-hardware checking of a microcomputer constructed on the basis of the K580IK80 LSI. Approximate time characteristics of the check software are presented, possible hardware expenditures are estimated, and the check algorithm for the microcomputer in the operating process is also investigated. There are 2 tables and 4 references.

UDC 681.3.06

INSTRUMENT COMPLEX FOR DEVELOPING MICROPROCESSOR SOFTWARE

[Abstract of article by Cheremisinov, D. I.]

[Text] A description is presented of the instrument complex designed for developing the software of microsystems which are devices with a stored program and one processor for which an instruction system is given. There are 2 illustrations and 6 references.

UDC 519.687.1:681.324

EFFICIENCY OF ALGORITHMS FOR OPERATIVE DISPATCHING OF COMPLEX PROBLEMS IN THE PACKAGE OPERATING MODE OF UNIFORM COMPUTING SYSTEMS

[Abstract of article by Bakenrot, V. Yu., Makarevich, O. B., Chefranov, A. G.]

[Text] A study is made of the operative algorithms for series-single dispatching of complex problems which can be used in the operating dynamics of uniform computing systems when solving a package of problems. The machine simulation method was used to establish their high efficiency with respect to the criterion of minimum package processing time. There are 5 illustrations and 5 references.

UDC 681.3:62-52

APPROACH TO PROGRAMMING REAL TIME SYSTEMS BASED ON A MICROCOMPUTER

[Abstract of article by Berezin, B. A., Tsyvinskiy, V. G.]

[Text] A discussion is presented of the concept of problem-oriented language media of a user of a controlling computer complex. The language media are designed for developing real-time programs and interaction with the system in the dialog mode. There are 5 illustrations and 12 references.

UDC 681.3.06

INCREASING THE EFFICIENCY OF SOFTWARE FOR ROBOT ENGINEERING COMPLEXES BASED ON A MINICOMPUTER

[Abstract of article by Grinshpan, L. A., Danilenko, V. K., Petson, Ye. L.]

[Text] A method is proposed for constructing a program for a minicomputer to control a robot engineering complex consisting of N machine tools and one robot. The reference point system for constructing supervisors of robot engineering complexes permits simplification of the operating algorithms and achievement of independence of individual technological processes. A method is also proposed for representing the trajectories of the robots and the machine tools in the form of frames permitting significant reduction of the size of the on-line memory for storing the data frames. There is 1 illustration.

UDC 681.3.06

BASIC SOFTWARE FOR THE GRAPHICAL DISPLAY EPP A5433

[Abstract of article by Govor, V. I.]

[Text] A description is presented of a package of graphical programs for working with the display EPP A5433. The package provides for input-output of graphical and alphanumeric information on a display screen, it offers broad possibilities of hardware and software editing of the image, and it organizes operation in the graphical dialog mode. There are 3 references.

UDC 62-52;681.3.06.44

PROBLEMS OF CLUSTER AUTOMATION OF ECONOMIC CALCULATIONS

[Abstract of article by Dubrovo, Ye. V.]

[Text] A study is made of the specifics of automating economic calculations under the conditions of using modern operating systems and data base control systems. One of the approaches to creating a set of packages of applied programs adapted to variable use conditions, each of which is oriented to a defined group of algorithmically identical economic calculations is proposed. There is 1 table and 3 references.

UDC 681.3.06:519.8

PLACEMENT OF FILES ON MAGNETIC DISCS WHEN DESIGNING DATA BASES

[Abstract of article by Zaikin, O. A., Katsev, S. B., Sovetov, B. Ya.]

[Text] A study is made of the problem of optimal placement of data base files on magnetic discs based on special characteristics of accessing the files. The criterion is minimizing the total run time of the heads when searching for the required files. The basic difference from the known models is that in addition to ordering the files on individual discs, the best distribution is found between different discs. The proposed algorithms are programmed in the PL-1 language. There are 3 references.

UDC 681.3.51

DIALOG DATA INPUT AND CHECK SYSTEM BASED ON THE SET OF YES7906 DISPLAYS

[Abstract of article by Androshchuk, Yu. N., Litvinov, V. A., Sapozhnikov, A. S.]

[Text] A study is made of the possibilities of using the resources of the central computer of an automated control system to prepare data. An analog data input and check system based on the YeS7906 display is described. There is 1 illustration and 2 references.

UDC 658.012.011.56:681.3.06

FORMAL DESCRIPTION OF SEMANTIC CONTROL AND CORRECTION OF ELEMENTS OF THE INFORMATION DATA BASE OF AN AUTOMATED PRODUCTION CONTROL SYSTEM

[Abstract of article by Khodak, V. I., Tsaregradskiy, L. Ye., Topolyanskiy, A. N.]

[Text] A formal nonprocedural description of semantic control and correction of the information base of an automated production control system is proposed. This permits automation of the process of obtaining and managing data structures which are effective for the solution of regular automated production control system problems. There is 1 illustration and 8 references.

UDC 62-52:681.3.053

DETERMINING THE OPTIMAL FORMAT FOR WRITING FILES OF DATA PROCESSING SYSTEMS

[Abstract of article by Terno, O. R., Treyger, V. I., Levi, V. S., Primich, K. I.]

[Text] Formulas are presented for the length of files and time for exchanging them with magnetic tapes as a function of the application of formats of fixed, variable and undefined length. A practical example of the choice of the optimal file writing format indicates expediency of using the presented formulas. There is 1 table and 1 reference.

UDC 681.3.06./94

APPLIED SOFTWARE OF A SYSTEM FOR AUTOMATION OF A PHYSICOTECHNICAL EXPERIMENT

[Abstract of article by Nikitin, A. M., Pshenichnikov, V. V., Sidorov, A. A. Simanovskiy, Ye. A.]

[Text] A structure is proposed for the applied software of a system for automation of a physicotechnical experiment permitting flexible variation of the experiment program. The problems of organizing the functioning of applied software in the multiprogramming real-time disc operating system M6000 are investigated. There are 2 illustrations and 2 references.

UDC 681.3.06:519.6

PROGRAM PACKAGE FOR NUMERICAL IMPLEMENTATION OF A TWO-PRODUCT MODEL OF DEVELOPED SYSTEMS

[Abstract of article by Ivanov, V. V., Besarab, P. N., Lyudvichenko, V. A.]

[Text] A description is presented of the functions, the structure and composition of a package of programs which implements an important case of the two-product model of developed systems. The possibilities of the package are described, and ways to develop it are indicated. There is 1 illustration and 8 references.

UDC 681.3.06

PACKAGE OF APPLIED NONLINEAR PROGRAMMING PROGRAMS WITH STRUCTURAL ADAPTATION

[Abstract of article by Amelina, N. I., Zhak, S. V., Pestrikova, Ye. Ya., Pyatina, N. N.]

[Text] A description is presented of a package of applied programs designed to solve complex optimization problems (oriented to the optimal design problems). It consists of a library of modules (optimization procedures) archive and control system realizing adaptation to the problem and to the course of the solution. The package is executed in PL/1 language for the operating system of the unified system of computers. There are 8 references.

UDC 681.3.06.44

PACKAGE OF APPLIED NONLINEAR ESTIMATION PROGRAMS

[Abstract of article by Chernomordik, M. B., Okrent, Ya. N.]

[Text] A new algorithm is proposed for nonlinear estimation of mathematical models which are nonlinear with respect to parameters. On the basis of this algorithm a package of applied programs has been developed for solving a broad class of nonlinear and poorly conditioned problems of identification and optimization with the possibility of selecting the estimate criterion. The package operates on the disc operating system of the unified system. There are 5 references.

UDC 681.3.51./6.42

PACKAGE OF APPLIED PROGRAMS FOR SOLVING THE TRANSPORT PROBLEM

[Abstract of article by Kavalerchik, B. Ya., Gurevich, M. D.]

[Text] A description is presented of a package of programs for solving the transport problem oriented to the solution of the problems of maximum dimensionality for the available size of on-line memory. The programs implement the method of deleting numbering and modified Hungarian method. The results of numerical experiments are presented. There is 1 table and 10 references.

UDC 62-52:681.3.06.44

AN APPROACH TO AUTOMATION OF THE CHECKING OF STUDENT KNOWLEGE OF MATHEMATICS BY COMPUTER

[Abstract of article by Kuznetsov, S. I., Sergiyevskiy, G. M., Popkova, Ye. B.]

[Text] A description is presented of the operating characteristics of a dialog system for checking the correctness of the proof of theorems. It includes the trainer for students to develop the construction of correct conclusions and the input language software. A study is made of the principles of realizing semantic analysis of the responses of the students when constructing the theorem proofs. An example of dialog between a mathematician and the computer and the parameters of the developed program complex are presented. There are 13 references.

UDC 65.011.56

SERVICING TIME IN AN AUTOMATED PASS CONTROL SYSTEM

[Abstract of article by Livak, D. M.]

[Text] Results are discussed from studying the servicing time in an automated pass control system of an enterprise which is considered as an ergotic system. There is 1 table, 4 illustrations and 11 references.

UDC 621.327.12

DEVICE FOR DISPLAYING SYMBOLIC INFORMATION ON A PLASMA PANEL

[Abstract of article by Lavrent'yev, S. I., Minenkov, V. A., Sviyazov, A. A., Smolyarov, A. M.]

[Text] A description is presented of a device for displaying symbolic information executed on the basis of a gas discharge matrix alternating current display panel 128 × 128. The functional diagram of the device, the operating principle of its basic assemblies, an external view and basic technical specifications are presented. There are 2 illustrations and 5 references.

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CSO: 1863/60

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